AMATEUR WORK

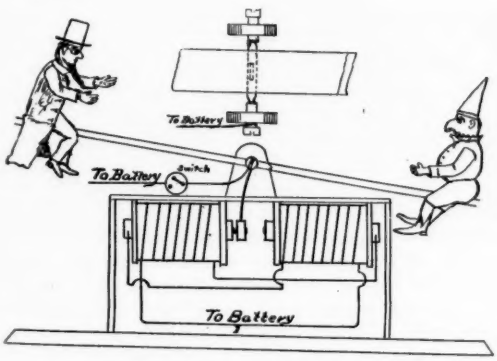
A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. IV. No. 7. BOSTON, MAY, 1905. One Dollar a Year.

ELECTRICAL WINDOW DISPLAY.

OSCAR N. DAME.

A novel electrical display, something out of the ordinary, will attract more attention than any other device. The following illustration shows an attraction which is easily made and well worth the short time required for its construction. The principle of this device is the see-saw, in which a suspended pendulum of iron acts as an armature and an electrical conductor as well. The horizontal beam must be considerably longer than the pendulum, even longer in proportion than shown in the illustration, so that a good tilting movement may be secured with a minimum of pendulum swing, for it will be seen that the play of the armature between the magnet poles is less than one quarter of an inch.



The beam is constructed of a strip of wood ½ in. thick and ¾ in. wide and is evenly balanced on the support as shown in Fig. 1, by means of a small pin-brad, soldered to it. If obtainable, the staff of the balance wheel of an old alarm clock and the two bearings for same make just the thing for this part, as it permits of close adjustment. The pendulum, made from a piece of watch spring, is also soldered to the staff or brad, and bears at its lower end a disc or washer of iron of sufficient weight to counterbalance the tilt-bar. This disc acts as the armature to the magnets.

It will be seen by the illustration that each side of the armature has a contact point of silver or platinum wire, and the attracting pole of each magnet is also tipped with a contact point of the same material.

The wiring diagram of this device must be closely studied to avoid mistakes. Each electro-magnet consists of a ½ in. core of iron 2 in. long, wound with 16 layers of No. 20 s. c. magnet wire. The ends of the cores project out from the winding ¼ in. The battery used is two cells of dry for occasional use, or three cells of gravity for window display. It will be seen by the diagram that one side of the battery is connected to the pendulum support. Then one end of one magnet winding is connected to the iron core of the other magnet. This occurs on both magnets. The other free ends of the magnet windings are connected together and to the other side of the battery.

All of this apparatus and wiring is intended to be covered from view by a box of wood, such as a cigar box, so that only the tilt bar and its support and the upper part of the pendulum are visible to the observer. One puppet should be a clown and the second a Rube. One puppet should also be a trifle heavier than the other, so that the tilt will not balance horizontally, in which case it would not make contact below on the armature. A switch should be placed in the battery circuit.

When the battery is thrown on, the circuit is completed through the pendulum, one core to the opposite magnet winding, back to the battery again. This puts the pendulum armature against the opposite magnet by magnetic attraction, and in contact electrically with the core of that magnet, thereby completing another circuit through core to the winding of the opposite magnet and back to the battery again.

In building this device, remember to reduce the pendulum length as much as posiible. Make the puppets of light wood or paper. Make the tilt arm long in proportion to the length of pendulum, and have the play of the armature between the magnet poles only sufficient to give a correct tilt to the tilt arm or bar. Paint everything in bright colors. A change of puppets will give additional interest.

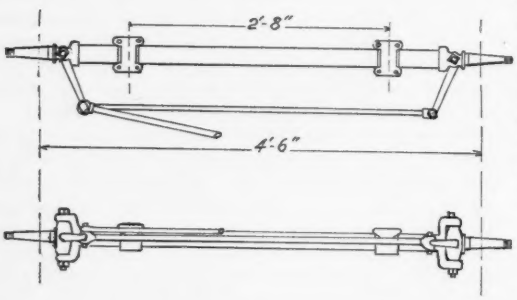
THE AMATEUR RUNABOUT.

FREDERICK A. DRAPER.

III. The Front Axle.

We have now reached a part of the work where the reader must rely upon his own diligence to a certain extent, provided he desires to keep the cost down to the lowest point. By this is meant that the exercise of a little "shopping" may be productive of important results in the way of securing finished parts all ready to be assembled at little or no greater cost than the wrought forgings would cost.

If the reader lives in the vicinity of any automobile manufactury or repair shop, a visit should be made to such places to learn what may be obtained there in finished state, and the writer's own experience is that such investigations will save much work. The body, springs, axles, hubs, spokes and other parts, were obtained in this way at a most satisfactory price to the buyer. Of course one has to take the parts as they are and adapt the vehicle he is making to the dimensions of such parts, but a little study will usually bring this out all right.



Those who have to make up the front axle will require two knuckles to fit hubs, as described in the last chapter, yokes for same, a piece of iron pipe about 1½ in. (iron pipe size), and two spring seats. The size of piping will depend upon the yokes, or a solid axle may be used, in which case a piece of square bar steel is welded to the yokes.

About the only dimensions that can be given, therefore, are those for the tread, 4 ft. 6 in. from center to center of the wheels. This is a trifle less than standard, but is suitable for a light car. The spring seats are also to be located to suit the body, and those with bolts for fastening are recommended, as the location can be changed if found necessary, which cannot be done if brazed on.

The ends of the knuckles are joined with a rod, ½ in. round steel being large enough. Yokes for the ends of these rods are to be had of dealers for a small sum, and can be easily forged to the rods. One knuckle, also, is connected to the end of the rod leading to the steering gear. A plain rack and pinion gear is ample for a car of this size and will be described later. It is mentioned here, as readers may feel inclined to get the more complicated and expensive kind, which is unnecessary.

As the rear axle will be taken up in the following chapter, readers should look up equalizing gears, as the shaft and gear casing will depend on the style of gear used. The general design of rear axle of the "Franklin" car is recommended as being simple of construction, strong and not likely to get out of order.

J. L. Haycock, Canadian inspector of binder twine, gives the following simple rule for determining the length of twine in a ball: "Take a sample ball, press the strands close together, and note the number required lying side by side to make an inch. Every strand within the inch will represent 50 feet in the pound. If ten strands lying side by side makes 1 in., then a pound will contain 500 feet; if eleven strands, 550 feet; if twelve strands, 600 feet, and so on. Having this rule in mind, anyone can test his twine for length, and need not be duped by short measure."

The Dominion Iron and Steel Company has, it is understood, decided to adopt at its works at Sydney, Nova Scotia, a new and inexpensive process for the manufacture of pig iron, utilizing waste iron ore, which costs from 60 to 75 cents a ton. Iron ore in this condition can be used only when it is solidified For a great many years chemists endeavored to solve this problem, but it was only a few years ago that W. Owen, consulting engineer and foreign representative of Bruck, Kretschel & Co., steel manufacturers, of Osnabruck, Germany, made the discovery. Since then the process has been adopted by seven German and two or three English steel companies, with eminent satisfaction. The waste is solidified, usually in bricks, and in this condition is placed in blast furnaces, when pig is produced. The plant which the Sydney Steel Company proposes to install will cost about $8000, and will have a daily output of about 75 tons. It will be the first of the kind erected on the continent, and the company will have exclusive use for the Dominion of Canada.

A RACING SAILBOAT.

C. C. BROOKS.

Concluded from the April Number.

PLANKING.

As both sides are alike, patterns are given for one side only, and as some of the planks are over 16 ft. long, the patterns of these are given in two pieces, as they will have to be put on in two pieces unless you have some 18 ft. lumber. Commence with the No. 1, or middle plank, and get it out from shape of pattern. It is best not to cut the center-board slot in this plank until after it has been fastened in place. Try the plank to place, clamping it down at the ends. You will now see that the lower edge of the end pieces must be beveled off to allow the ends of the plank to come into place. This beveling you will do by trimming off the edge of the end piece until the plank lays fair upon it.

Although the pattern shows the shape of the ends of the plank, it is advisable not to cut the ends of the the planking to shape of patterns, but to leave all the plank a little long so that they will extend beyond the ends of the boat a few inches; then after it has all been fastened to place, it may be cut off flush with the ends of the boat. Put on in this way, it is less apt to split at the ends when nailing.

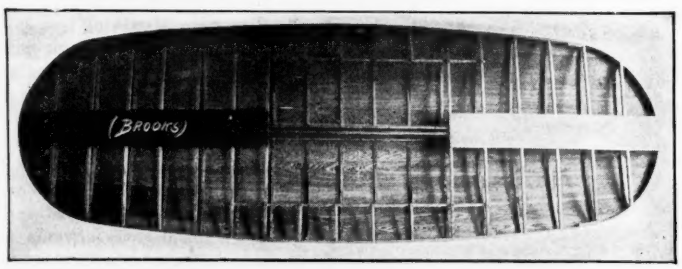


FIG. 7.

You must, however, be careful to have the edges of the plank fit tightly together. The seams should be tight on the inside and a little open, say 1-16 in. on the outside, for calking. When putting on each plank, bevel the edge with a plane until it fits. Fasten the plank to the back-bone with 12-in. wire nails. Around the centerboard slot, nail close—say one nail every inch. Slightly stagger or zig-zag these nails to prevent their splitting. Fasten all planks to the ribs with 1½ in. clout nails, three or four to each plank, at each rib. The ends of the plank are fastened to the end pieces with 2 in. wire nails. The outside edge of the outside plank is fastened to the side with 2-in. wire nails.

The bottom edge of the side pieces must be beveled, so that the planks lay flat on them. The outside plank is closely nailed to the side the same as with the plank around center-board slot. When driving all nails, hold a clinch-iron (flat-iron will do) on the inside. After all plank are on, set in all nails about ⅛ in., with a nail set, holding on clinch-iron when setting nails. The joint or butt of those plank that have to be put on in two pieces may come on a rib or half way between two ribs, in which latter case butt blocks of ⅜ in. oak may be put on the inside, with the ends of the planks nailed to them. (Note instructions for canvas covered planking.)

Nail two or three stays or braces across the top of the boat, from side to side, to prevent its spreading; then turn the boat over, right side up, and put in the deck beams. These are the same size as the ribs and are put in and fastened in the same manner. The deck-beams, however, will not require steaming as they will bend easily to place when cold. You will note in Fig. 7 that those beams that come alongside the cock-pit do not extend clear across, but end on a fore and aft piece. This piece is the same size as the deck-beams. After putting in the long deck beams, put in the two fore and aft pieces that support the short deck beams. These pieces are put under the deck beams and fastened to two of the long beams at each end. They are fastened with one 1½ in. No. 12 screw at each beam. The inner ends of the short neck beams are fastened to the top of these pieces with one 1½ in. screw in each.

The deck frame when in will show an opening for cockpit 5 ft. long and 4 ft. wide. Lay the decking on the deck frame in the same manner as the planking.

As the neck is made simply of straight pieces, no patterns are necessary. After the deck is on, trim it off to shape of outer edge of boat and the cockpit. The deck may be either calked or covered with canvas. We recommend the latter method. If deck is calked, the nails should be set the same as was planking. If deck is canvas covered it should first be planed and sandpapered smooth and all cracks filled with putty.

To canvas the deck will require 5 yds. of 6-oz. duck. The canvas or duck may be sewed or tacked together in the seams. The seams of the canvas may be run crosswise of boat. First, give he deck a coat of paste and lay the canvas on while t is wet, working out all the wrinkles. Fold the canvas over the edge and tack it. If the canvas has not been sewn together it must

be lapped about ¼ in. at the seams and tacked closely.

COAMING.

The coaming is simply four straight pieces that go around and finish the edge of the cockpit. Get the coaming out of the waste lumber left from planking. It will take two pieces 5 ft. and two pieces 4 ft. long. Have it about 5 or 6 in. wide, so that it will extend at least 4 in. above the deck. Fasten the coaming to the deck beams with 4d in. clout nails or 1 in. screws could be used. A piece of ¼ in. quarter-round may be bent around coaming, next to the desk to give a finish, as shown in Fig. 8.

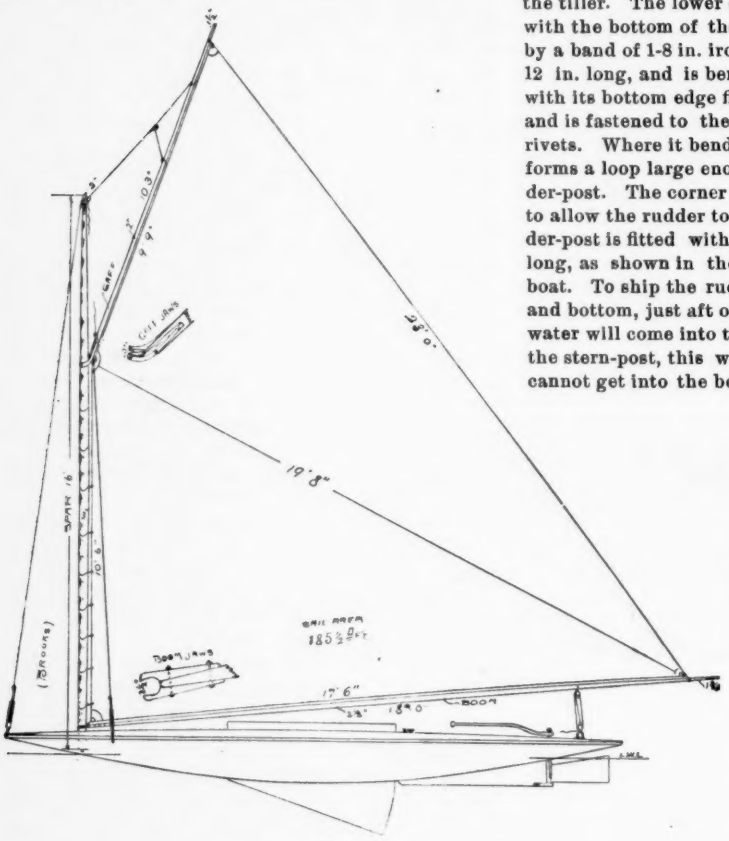


FIG. 10.

FENDER-WALE.

This is a piece of ¾ in. half-round which is bent around the outside edge of boat flush with the top of the deck. This piece covers the edge of the canvas. The parts that are bent around the end will have to be steamed or soaked in hot water. The fender-wale is fastened in place with 8-penny casing nails. Before putting on fender-wale, see instructions for putting on chain-plates, as these are best put on under the fender wale.

SKEG.

Cut out the skeg from the pattern and fasten it in place on the outside of the planking, forward of the stern-post, B, putting three or four 4 in. wire spikes through the stern-post into the skeg, ahd three or four through the skeg and planking into the butt block.

RUDDER.

Make the rudder of iron 1-8 in. thick and rivet it to a 1 in. round iron rudder-post. The rudder-post extends up through the deck its upper end about 3 in. above the deck. This end is forged square to receive the tiller. The lower end of the rudder-post ends flush with the bottom of the skeg, where it is held in place by a band of 1-8 in. iron 1 in. wide. This band is about 12 in. long, and is bent around the end of the skeg, with its bottom edge flush with the bottom of the skeg and is fastened to the sides of the skeg with bolts or rivets. Where it bends around the end of the skeg it forms a loop large enough to take the end of the rudder-post. The corner of the rudder-plate is cut away to allow the rudder to be shipped. The top of the rudder-post is fitted with an iron tiller about three feet long, as shown in the illustration of the completed boat. To ship the rudder, a hole is bored in the deck and bottom, just aft of the stern-post. Although the water will come into the space in the backbone aft of the stern-post, this will do no harm whatever, as it cannot get into the boat.

CALKING.

Use a small calking iron and mallet. To calk the lark will require a 1 pound roll of calking cotton. When calking, start at the end of a seam and calk in the end of the thread. Let the thread hang down from the seam, then gather up an inch or so of the thread and drive it in, slightly advancing along the seam; this will show a fullness or loop of cotton that has not been driven in. This is so you can regulate the amount of cotton to the condition and opening of the seam by making the fullness of the loop as close as desired. After calking a few feet, go back

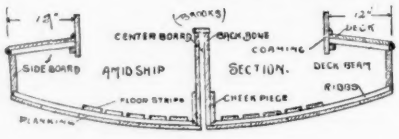


FIG. 8.

over it again and drive it home Do not use too heavy a mallet or drive the cotton too hard; it is only necessary that it is firmly in place. As the plank are light, care

will have to be taken not to get in too much cotton because after the boat is in the water, both the cotton and plank will swell. A little judgment will tell you how big a thread of cotton to use, and a little practice will show you. Fill the seams about two-thirds full of cotton.

When calking a seam that is tight on the outside, first, drive the iron along the seam to slightly open it before trying to calk in the cotton. First calk the butts between the ends of such streaks of planking as have been put on in two pieces, then calk the seams between the plank, calking the tightest seams first and leaving those that show the most opening to be calked last. The seam between the sides, ends and bottom is not calked. After boat is calked, smooth it down with sand paper and give outside a priming of white lead and oil, working it well into seams with a narrow seam brush. When dry, putty seams, butts and nail heads, and then give outside two more coats of paint. A good white paint is made by using equal parts of boiled oil and turpentine mixed with equal parts of white lead and zinc. The bottom of the boat may then be given a coat of copper paint, which will act as a preservative in hot water and also prevent the fouling of the hull by moss in fresh water. The coaming, fender-wales and deck, if not canvassed, should be finished in natural wood. First scrape smooth and sandpaper, putty all brad heads, then give three coats of spar varnish. When painting or varnishing let each coat dry well before putting on the next.

The bottom of the cock-pit may be fitted with a tight floor of half-inch stuff or with open slats as shown in Fig. 8.

CENTER-BOARD BOX CAP.

In the instructions for making the center-board, we told you to connect its after top edge with a chain. For this boat a chain is better than a rod for the reason that when the board is only half way down, the rod will be in the way of the boom swinging.

For the chain use a dog chain or any small chain that will allow of the spike being put through the links to hold the board in place.

Fit a cap on the top of the center-board box, letting it extend from the forward end back to within a couple of inches of the after end. (See Fig. 8.)

The dimensions of the spar, boom, gaff, sail, etc., are given in Fig. 10. To make the spar, take a square piece and dress down the corners until it is eight squared, that is, has eight instead of four equal surfaces. Then repeat the operation so as to give sixteen sides to the piece after which it may be easily planed and sandpapered perfectly round. Leave the spar the full size to within three feet of its top, the top three feet being tapered to half size. Make the boom and gaff in the same way. The jaws of the boom and gaff are made of oak and shaped as shown in Fig. 10. Bolt in place with ½ in. carriage bolts. Bore one ⅝ in. hole near the after end of the boom and gaff, and two holes hrough the jaws of each, close to the end of boom and gaff. These holes are to take the lacings that hold the sail at the corners.

Fasten the upper or peak halyard block to the spar with a ½ in. eye-bolt, locating this bolt six inches below the top of the spar. Fasten the lower or throat halyard block in the same way, one foot below the peak halyard block. Bore the holes for these eye-bolts so that the blocks will come on the after side of the spar. For mast stays, cut three pieces (legs) of ¼ in. wire rope rigging 15 ft. long, and splice an eye in one end of each just large enough to go over the top of the spar. These eyes will slip down and rest on the eye-bolt that hold the peak halyard block.

CHAIN PLATES.

The chain-plates are made from ¼ in. band iron 1 in. wide, are fastened to the sides and end and hold the turn buckles as shown in Fig. 11. The chain plates should be 3 in. long with an eye at top to take bolt of turnbuckle. Drill and countersink four holes in each and fasten them in place with 1 1-8 in. No. 12 screws. The forward chain-plate is located at the center of the bow and the side chain plates are located at a point eight inches aft of the center of the spar.

Now, cut the hole in the deck for the spar. This hole is directly over the mast step so that the spar will stand plumb. A collar of oak may be put around the hole and screwed to the deck to reinforce it.

Set the spar in place and pass the three lower ends of the wire rigging through the top of the turnbuckles and seize the ends back to the standing part. By seizing is meant to wind a piece of string or marline about both parts.

Set up the turnbuckles so as to take out the slack, and bring the rigging down to place, after which it may be loosened and the lower ends spliced to place.

SAIL.

When possible, it is always best to have the sail made by an experienced sail maker. However, some amateurs have turned out very creditable sails. The sail is stitched on a sewing machine with coarse linen thread. The sail for the lark should be single bighted, that is, a fold is taken in the middle of each breadth so as to form a hem or seam one inch wide. This seam is stitched on both edges. A small hem is stitched around the outer edge of the sail through which is run a ¼ in. piece of cotton rope. This rope ends with a knot at the after end of the boom so that the slack in it may, from time to time, be taken up. If sail is roped on the outside no hem is used, the rope being sewed directly to the edge of sail with palm and needle. When roped in this way use ¼ in. bolt rope, and starting one foot from the bottom on the after edge, work round to a point one foot from the top of the after edge. This will leave the most of the leach or after edge without bolt rope. This edge is simply hemmed between the ends of the bolt rope. One set of reef points is worked in 3¼ ft. above the bottom edge. These points are pieces of ¼ in. cotton rope. One reef point is put in each seam, excepting the outer edges.

For the reef points, work a hole (same as button hole) and, cutting off the cotton in four foot lengths, seize the ends with twine and sew the middle in the hole worked in seams. The sail is reinforced at the four corners with a patch, as shown in Fig 10.

Work holes in each corner of the sail, also along the lower edge, every six inches, to lace it to the gaff holes along the forward edge (throat) every eighteen inches, to tie it to the mast hoops.

TO BEND ON THE SAIL.

Fasten the four corners of the sail to the boom and gaff, by splicing one end of a piece of the cotton rope into the corner holes of the sail and then lacing it with a couple of turns through the holes on boom and gaff. The corners at the forward end, or throat, are laced down tight to the jaws of the boom and gaff. Do not stretch the sail, as the slack had best be taken up after the sail has been used. Lace the sail to the boom and gaff by simply running a piece of the cotton line around and around these pieces, the lacing being put through one of the holes in the sail, at each turn.

RUNNING GEAR.

Staple a single block on each side of the spar, as shown in Fig. 11. Fasten a single block with a short bridle of manila line to the gaff for the peak halyard. Fasten a single block directly to the jaws of the gaff with a short piece of marline. Hook a single block with becket to each of the eye-bolts in the spar. Splice the end of the peak halyard into the becket of the upper block on the spar and then reeve it through the block that is bridled to the gaff, then reeve back through the upper block on spar and on down through the block on deck, from which it leads aft through a hole in the forward side of coaming to a cleat that is fastened to the after end of the center-board box. Splice the end of the throat halyard into the becket of the lower block on the spar, then reeve it through the block at the jaws of the gaff back through the block to which it is spliced, and down to the deck block on opposite side from peak halyard, thence back through hole in coaming to a cleat on after end of the center-board box.

SHEET.

The in-board block of the sheet is fastened to a ring on a traveler which is fastened to the deck, half way between the rudderpost and the stern, as shown in Fig. 10. The traveler is 18 in. long and is made of $\frac{3}{8}$ in. iron and may be fitted with plates to screw to the deck or bolt through the deck, as shown in Fig. 12. Hook a block with becket to traveler ring and seize a block to the boom at a point that will be just over the traveler when the boom is amidships. Splice the end of the sheet into a becket of the block on the traveler from which it will lead forward to a cleat on deck just aft of the coaming. The ends of all lines should be whipped to prevent their unlaying. To whip a loose end, wind it with twine, sewing the twine through and around the windings with a coarse needle. When sailing, you will need a short stick to push the center-board down. No seats are used in a Lark. Instead, a cushion is used on the floor of the cockpit. All the blocks should be moused to prevent their unhooking. Mousing means to tie a turn of marline from the top to the shank of the hook.

CANVAS COVERED PLANKING.

Built in this way, no calking is necessary and, instead of using $\frac{5}{8}$ in. planking, $\frac{1}{4}$ or $\frac{3}{8}$ in. is used. We advise the $\frac{1}{4}$ in. It will take the same number of surface feet and the plank is put on in the same way, excepting that $1\frac{1}{2}$ in. clout nails would be used for a $\frac{1}{4}$ in. plank and $1\frac{1}{4}$ in. clout nails for a $\frac{3}{8}$ in. plank. To cover the plank with canvas will require 8 yds. of $14\frac{1}{2}$ oz. duck 30 inches wide, and 6 pounds of marine glue. After being planked the bottom is sand papered smooth, the nails heads being only set flush. Fill any crevices with putty and then apply the glue. The marine glue, when cold, is hard, having about the consistency of molasses candy. To apply it, it must be heated and put on hot, and even then it will be found too stiff to spread nicely and will simply have to be daubed on as evenly as possible. An ordinary whisk broom, cut off short so as to be stiff, makes a good brush with which to apply it. After the glue is on it will immediately harden. Then spread over the canvas, putting this on one breadth at a time and having it run crosswise at right angles to back-bone. Secure each breadth in place with a few tacks and, commencing in the middle of the breadth, iron it out with a hot flat iron, keeping the iron just hot enough not to burn the canvas. This will cause the glue to melt and join firmly to the canvas. Let the edges of each breadth lap the adjoining one for $\frac{1}{4}$ in. and let the canvas come over the edge of the boat and lap 1 in. on to the sides and ends. This edge is closely tacked with 2 oz. tacks, as is also the edge around the center-board slot. A double row of tacks is put in the lap at each seam.

The Canadian "Gazette" says the Postmaster-General has had under consideration the liability of articles of celluloid to explode or catch fire under certain conditions, cases having occurred that strongly pointed to mails being injured from this cause. It has been decided that such articles may in future be mailed only if packed in tin boxes with closely fitting lids. Notice is therefore given that celluloid is regarded by the postal authorities as an explosive, and the mailing of such articles, except as prescribed, is prohibited and renders the sender liable to prosecution under section P of the post-office act relating to the sending of explosives, matches, etc., in the mails.

The hand that sets out a shade tree confers a blessing upon present and future generations, and immediate reward will be had from increased value to property. The coming spring will be the right time to begin.

INTERFERENCE IN WIRELESS TELEGRAPHY.

JOHN STONE STONE.

Of the various problems which have been presented in the course of the development of the new art of wireless telegraphy, none is of greater interest to the engineer, and none is of more far-reaching importance from the industrial and commercial standpoint than that of rendering the receiving instruments of wireless telegraph stations immune from interference.

There are two principal kinds of interference.

I. Interference which arises from electrical charges which accumulate upon the vertical oscillator under various conditions of weather, provided the vertical oscillator has no adequate electrical connection to the earth.

2. Interference which arises from such stray electromagnetic waves as are produced by lighting, by magnetic storms, by sparks in neighboring circuits, such for instance at occur in trolley circuits, and also from wireless telegraph stations other than that with which communication is desired.

INTERFERENCE DUE TO STATIC CHARGES.

The interference which results from the first of those two sources is readily overcome since the oscillator of a wireless receiving station may always be given a metallic connection to the earth sufficient to maintain it clear of statistical charges without in any appreciable degree interfering with its operation as a receiving oscillator.

Thus, for instance, if the vertical oscillator includes a condenser insulating a portion of the vertical oscillator from the earth, the condenser may be shunted by a coil of inductance so large that for the high frequencies employed in wireless telegraphy it shall operate practically as an open circuit, while affording a ready path to earth for the electrical charges which would accumulate upon the vertical oscillator and produce disruptive discharges to earth.

Again, if a highly sensitive detector or receiving device be included directly in the vertical receiving oscillator, such an inductance coil may be placed in shunt to the receiver without appreciably affecting its apparent sensitiveness. The coil will then serve as a by-path for the currents due to the passage of the charges of the vertical oscillator to the earth.

Another device which may serve to still further protect the receiver under these conditions is that illustrated in Fig. 1, in which V and V are portions of the vertical oscillator system, L is a coil of large inductance, R is the receiving device, and C is a condenser of capacity so large as not to impede appreciably the passage of the high-frequency oscillations of wireless telegraphy while acting practically as an open circuit for the more slowly varying currents by which the vertical oscillator is maintained free of static charges.

The greatest security from this form of interference is, however, obtained by providing the vertical receiving oscillator with an adequate conductive connection to earth and by placing the receiving device in a local circuit made resonant by a coil and a condenser to the frequency of the electrical oscillations to which the receiver is intended to respond.

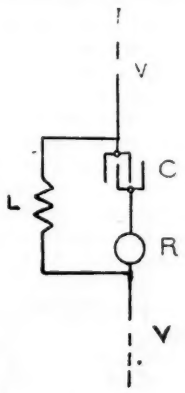


FIG. 1.

An example of such an arrangement is shown in Fig. 2, in which VI_2 is the vertical receiving oscillator I_1 I_2 are the two coils of a high-frequency transformer, R is the receiver, C_2 is a condenser and L_2 is an inductance coil.

The manner in which the local circuit containing the receiver is made resonant to the frequency of the oscillations which it is intended to respond will be considered later in this paper. It is sufficiently high that the local circuit being resonant for the purposes of wireless teleggraphy will not be appreciably affected by the more slowly varying currents in the vertical oscillator by which the latter is maintained free from static charges.

INTERFERENCE DUE TO ELECTRCMAGNETIC WAVES.

Coming now to the prevention of interference by electromagnetic waves such as emanate from other wireless stations than that with which it is desired to hold communication, and to the prevention of interference by stray electromagnet waves, we find the solution of the problem depends upon the character of the message-bearing waves, the energy of which it is desired to convey to the receiving device, and also upon the character of the disturbing waves, the energy of which it is desired to exclude or divert from the receiving device.

We can control the character of the waves whose energy we wish to receive, by suitably designing the apparatus to be used at the transmitting station, but we have no control over the character of the disturbing waves, except in so far as these arise from wireless stations within operative range of the receiving station.

The simplest solution of this problem is to cause each transmitter to send out its signals by means of persistent trains of simple harmonic waves of a frequency materially different from that employed by any other transmitter within operative range of the receiving station with which communication is to be maintained and to make each receiver responsive only to persistent trains of simple harmonic waves of the frequency employed by the transmitter with which it is in commu-

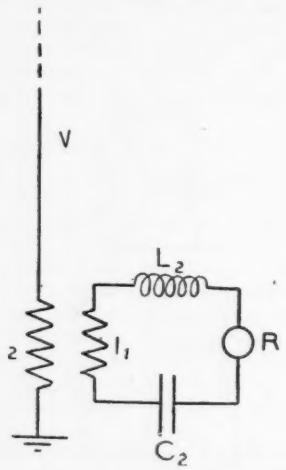


FIG. 2.

nication.

By this means the system is rendered selective and becomes a multiple system of telegraphy, permitting he operator at each station to select the station with which he wishes to hold communication to the exclusion of all other stations, and by which a number of messages may be transmitted simultaneously in a given region without interfering with one anothe.

Since the stray electromagnetic waves arising from lightning, etc., are not persistent trains of simple harmonic waves, but partake more of the character of isolated impulses, the receiver in such a system does not respond to such stray electromagnetic waves and it is therefore freed from interference which would otherwise arise from such sources.

The manner in which a transmitting station is made to develop persistent trains of simple harmonic electromagnetic waves of one frequency to the exclusion of other frequencies, though simple in itself, in practice requires the strictest attention to certain details, and these may be best understood by the consideration of a concrete case, this being the manner in which such problems are usually presented to the engineer if not to the inventor.

TRANSMITTER.

In modern wireless telegraphy the messages are transmitted by electromagnetic waves which are horizontally polarized at the earth's surface, and which are developed by electrical oscillations whose axis is normal to the surface of the earth and which is connected to the earth at its lowest extremity.

The reason for employing waves of this type and so developed, is that such waves have, at the earth's surface, no component of electric force parallel to the surface and no component of the magnetic force normal to or cutting that surface, except in the immediate neighborhood of the base of the transmitting oscillator. As a result they do not tend to induce currents in the surface of the earth as they travel away from the transmitter except where the surface of the earth deviates from the plane of polarization of the waves at that surface. The energy which would otherwise be rapidly dissipated through the production of induced currents in the earth is therefore conserved in the waves. Moreover, when a deviation occurs between the plane of the earth's surface and the plane of polarization of the waves at the earth's surface, the currents induced in the surface of the earth are such as to bend the wave front into a position normal to the surface with the result that the waves travel over and around mountains and in fact follow the earth's surface whatever be its contour, instead of tending to travel in straight lines

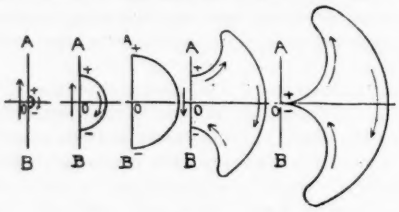


FIG. 3.

like ordinary light waves and as would be the case with vertically polarized electromagnetic waves.

There is not space in this paper to discuss in detail the development of the waves described above, but their genesis and mode of propagation are clearly suggested by Figs. 3 to 8. Fig. 3 and Fig. 4 illustrate the development of a wave by free electrical oscillations in a straight wire AoB, the curve lines indicating a a line of electric force in its various phases from $t=0$ to $t=\frac{1}{8}T$, where T is the time of a complete free electrical oscillation in the wire. In Figs. 5 and 6 the genesis of a wave from a vertical linear oscillator, AO, earthed at its lower extremity, is illustrated, and in Figs. 7 and 8 the effect of an elevation and depression in the surface of the earth upon the wave fronts at that surface is indicated.

We may next consider the earth connection of the transmitting oscillator and the nature of the supports for the oscillator.

Although, by the use of such waves as are described above, normally the current density in the surface of the earth at a distance from the transmitting oscillator is rendered excessively small, nevertheless at and in the immediate neighborhood of the base of the vertical oscillator, the current density is in general very great. Moreover, since the current is of high frequency, it tends to flow only on the surface of the earth. For this reason the usual specifications for obtaining a good earth connection which involve burying a conductor of large area so deep in the ground that it shall be in permanently moist earth are no longer advantageous, and in a properly constructed wireless telegraph station the conductivity of the surface of the earth in the immediate neighborhood of the base of oscillator is artificially increased by a superficial ground-plate composed of sheet metal, or of wire netting, extending radially from the base of the oscillator and covering as large an area about the base of the ossillator as is available for the purpose and consistent with reasonable economy.

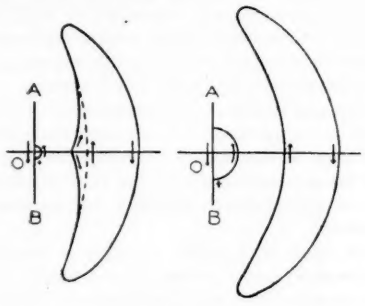


FIG. 4.

Since the waves are horizonally polarized, the supports for the vertical oscillator, such as masts or guy ropes, should either be of insulating material or, if of metal, they should be divided by insulation into sections short compared to one-half the wave length of any of the waves to be employed. The reason for this is that the fundamental free period of vibration of a linear conductor is such as to respond most energetically to waves of twice its own length. For such wavelengths, therefore, the linear conductor would absorb an undue amount of the energy of the waves and moreover because of the rise of potential which occurs at the ends of the conductor for waves of such length it would be difficult to insulate the conductor from the earth or adjacent portions of the support of the vertical oscillator.

We come now to the vertical oscillator itself. This in general consists of two parts, the elevated conductor *per re* and the devices through which it is connected with the earth.

We shall here consider the relative simple case in which the elevated conductor is a straight, cylindrical copper wire of length a and radius p.

Both theory and practice show that the electrical vibrations in such a wire connected directly to the earth at its lower extremity correspond very closely to the transverse vibrations of a heavily damped stretched string.

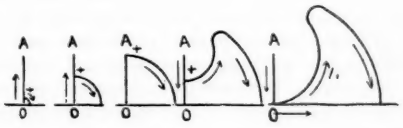


FIG. 5.

If such a wire be charged to a high potential and be then permitted to discharge to earth, the electrical oscillations developed in it, and therefore also the electromagnetic waves radiated by it, will not be simple harmonic type and will not be persistent. These waves will not, therefore, correspond to the sound waves given out by a tuning-fork, but will be of the character of those given out by a heavily damped violin string plucked at its center.

The fundamental of the waves given out by such an oscillator has a wave-length which very closely approximates four times the length of the wire, and this is accompanied by all the odd harmonics. The oscillations are so much damped by the energy drawn off by the energy drawn off from the oscillator by radiation as to make the resulting waves more nearly an equivalent of an impulse than of a sustained or persistent train of waves.

If, however, the elevated conductor be not directly connected to the earth, but be connected to it through an inductance coil, both theory and practice show that its electrical vibrations correspond to the transverse vibrations of a heavily damped stretched string with a mass attached to its center.

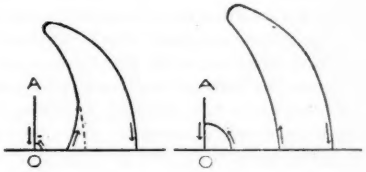


FIG. 6.

The effect of the load at the center of the stretched string and of the inductance at the base of the vertical wire is to increase the persistency of the vibrations, to minimize the importance of the harmonics and to lower the frequency of the fundamental.

It might, therefore, seem that in order to cause the vertical oscillator in question to radiate a persistent train of simple harmonic waves of a predetermined frequency, it would be sufficient to charge the vertical wire to a high potential and permit it to

discharge to earth through an inductance coil of suitable dimensions.

This, indeed, was the plan adopted in the first crude attempts to produce a selective system of wireless telegraphy. This method necessitates the use of waves of much lower frequency than that normally produced by natural vibrations of the vertical wire *per se*.

The degree of persistency of oscillations so obtained, however, is not as great as is required in practice. Such persistency as is obtained is gained at the expense of the amplitude of the current oscillator, the latter being *caetiris paribus* less for low than for high frequencies. Moreover, the spark in the vertical oscillator which normally dissipates an undue amount of the energy of the oscillations, has its resistance enhanced by the reduction of the amplitude of the current oscillations due to the presence of the inductance coil.

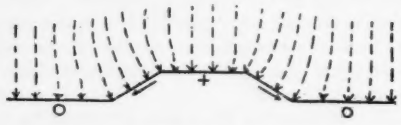


FIG. 7.

The latter difficulty may in a measure be overcome at the expense of any increase of the energy supplied to the oscillator, by shunting the spark gap by a condenser of large capacity. The discharge of the condenser across the spark gap increases the current through the spark and thereby reduces its resistance and damping effect upon the oscillations. The damping effect of the radiation still remains and the persistency is still too much limited for practical purposes.

So far we have considered only the natural oscillations of the vertical oscillator which are produced by charging the elevated conductor to a high potential and then permitting it to discharge to earth. When, however, a high degree of persistency, a pure sine wave and a great amplitude of oscillation are desired, the spark gap is removed from the vertical oscillating circuit and a simple harmonic electro-motive force is impressed upon the vertical oscillator in its place. The resulting vibrations in the vertical oscillator are then forced simple harmonic vibrations. In order that they may be of great amplitude, the frequency of the impressed force is made to correspond to the fundamental of the vertical oscillator or to one of its harmonics, in which cases the reactance of the vertical oscillator is nil.

A simple arrangement for producing forced, simple harmonic vibrations in the vertical oscillator is shown in Fig. 9 in which G is an alternating-current generator, K is a key, P shows the connection to the terminals of the primary of a spark coil, C is a condenser, L is an inductance, I and I_2 are the primary and secondary coils of a high-frequency transformer, V is the vertical wire and E is the earth.

There is a variety of ways in which substantially the same results may be accomplished, but there is not space in this article to consider more than one arrangement. * * * * * * * * * * *

Concerning the arrangement illustrated in Fig. 9, there is much of detail which requires attention in order that the apparatus shall satisfactorily fulfil the requirements of radiating a persistent train of simple harmonic waves. For instance, if a dialetric having considerable electrostatic hysteresis be employed in the condenser, a surprisingly large amount of energy will be dissipated in this dialetric. The magnitude of this loss is due to the fact that the energy dissipated increases both the potential difference employed at the terminals of the condenser and also with the frequency. Since the potential difference employed at the terminals of the condenser amounting to 50,000 volts and oscillations having frequencies of 5,000,000 are not unusual in wireless telegraphy, it is easy to see that the losses in the dialetric of condensers employed in the usual power or lighting circuits.

Moreover, the specific inductive capacity of most dieletrics is a function of the density of the displacement current in the dieletric, and when such dieletrics are employed in the condenser in an oscillating circuit, the resulting oscillations are not simple harmonic in form and are not isochronous throughout the train.

Air condensers should therefore be used in wireless telegraphy to the exclusion of any other type pending the publication of the results of certain investigations which are being conducted with the view of supplying a dieletric of high dieletric strength and constant specific capacity.

The coils used in wireless telegraphy should not have iron cores except the iron be very finely comminuted and imbedded in a non-hygroscopio dieletric matrix. It has even been found by the author that coils wound on a wooden cylinder do not operate satisfactorily when used in the oscillating circuits of wireless telegraphy. The coils for this purpose are

FIG. 8.

best constructed by winding a few turns of bare copper wire in a single layer on a skeleton frame made of ebonite, care being taken to separate the turns by such an amount that the sum of the air spaces between the wires of the turns is equal to or slightly greater than the sparking distance in air corresponding to the greatest potential difference liable to occur at the terminals of the coil when the apparatus is in operation.

An isolated circuit of the type shown in Fig. 9, may be made to give extremely persistent simple harmonic oscillations, but if it be given a large coefficient of mu-

inductance with another oscillator of relatively low persistency, such as the vertical oscillator VI_2E of the arrangement shown in Fig. 9, two things happen. In the first place the two oscillations of the circuit are in general no longer simple harmonic, but are broken up into two simple harmonic oscillations of different frequencies, and in the second place the persistency is greatly reduced.

To overcome this difficulty it is necessary either to make the magnetic leakage of the high frequency transformer, connecting the local oscillating circuit with the vertical oscillator, unusually large, or else to the local oscillating circuit an inductance coil M, with sufficient inductance to swamp by its effect the reaction from the secondary circuit.

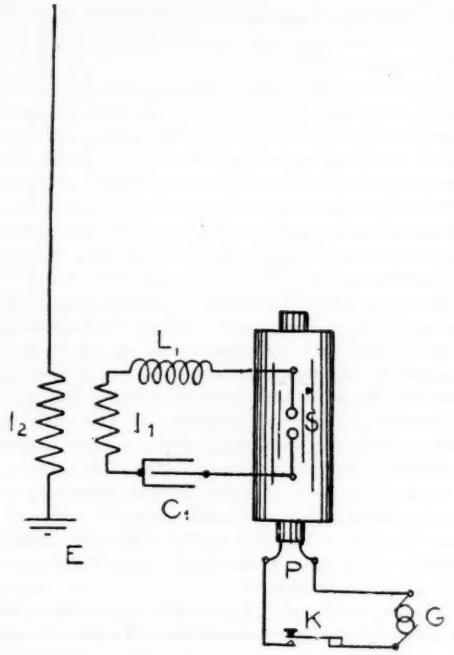


FIG. 9.

When intense radiation is desired, it is necessary to make the capacity S of the condenser C_1 in the local oscillating circuit large compared to S_1, the apparent capacity of the elevated conductor *per se*, for the frequency employed.

RECEIVER.

Since the electromagnetic waves to be received at a wireless receiving station are horizontally polarized at the earth's surface, an electrical oscillator whose axis is normal to the earth's surface is employed at the receiving station. This oscillator may either be connected to earth at its lower extremity or it may be connected to a device having reactance equal for all frequencies to the reactance of the vertical oscillator. It is to be remembered in this regard that at the receiving station we are not concerned with what becomes of the energy which is dissipated by the reradiation of the energy from the receiving vertical oscillator.

We shall consider again a simple concrete case, and shall assume the elevated conductor to be a cylindrical copper wire of length a and radius p as in the case of the transmitter, though it must by no means be assumed that the elevated conductor at the receiving station must necessarily be similar to that at the transmitting station, or, in fact, that it must bear any resemblance to that at the transmitting station except in so far as its axis is preferably normal in the surface of the earth.

As in the case of the transmitting station, only one simple arrangement of the apparatus sufficient to give the desired result will here be considered. By this arrangement messages transmitted by means of persistent trains of simple harmonic electromagnetic waves of a predetermined frequency may be received to the exclusion of similar waves of materially different frequencies and without interference by impulsive waves. Such an arrangement of the circuits and apparatus is shown in the diagram, Fig. 11. In this arrangement the receiving device which is indicated at R is placed in a local circuit $C_3I_3L_3R_3$ which is made resonant to the frequency of the waves to which the station is intended to respond, and a second resonant circuit C_2I_1 I_2I_2 resonant to the same frequency and called a "weeding-out circuit," is interposed between the first mentioned circuit and the vertical oscillator.

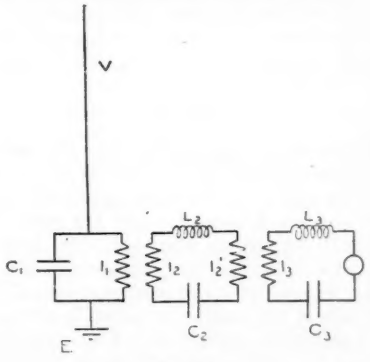


FIG. 11.

The branch circuit, consisting of the coil I_1 and the condenser C_1, is not, when taken by itself, resonant to the same frequency as the other local circuits, but so proportioned that when connected as a branch circuit, forming a part of the vertical oscillator system, the latter shall respond most energetically to persistent trains of waves of that frequency falling upon the vertical wire.

The way in which this is accomplished is perhaps more easily seen by a graphical demonstration than by

the use of the analytical solution, though the latter is by no means difficult.

The curves in Fig. 12 illustrate the point in question. Curve 1 represents the reactance of the vertical wire measured at the point of its attachment to the loop circuit, for varying periodicities of the impressed force. It will be seen that the periodicity of the fundamental of the vertical wire at the point n_1'', where the reluctance first vanishes. The first even harmonic is at n_2'', and the periodicity of its first odd harmonic is at n_3'', where the reactance again vanishes. Normally, therefore, curve 3, which is the current curve for varying

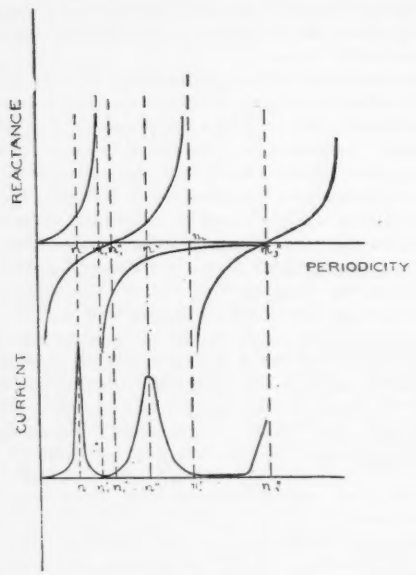


FIG. 12.

periodicities of the impressed force on the vertical wire would show maxima at n_1'' and at n_3''. The reactance of the loop circuit for varying periodicities of the impressed force, measured across the points of its attachment to the vertical wire and earth connection is shown in curve 2. The total reactance of the vertical oscillator measured at the earthed terminal is the algebraic sum of two reactances shown in curves 1 and 2, and as a result the current curve 3 shows maxima, not at n_1'' and n_3'', but at periodicities n, n'' and at a periodicity slightly higher than n_3''.

These are the points at which the reactance of the loop circuit is equal, but opposite in sign, to that of the vertical wire.

The periodicity of the local loop circuit *per see* is n_1', and for this periodicity the current in the vertical wire is practically nil.

The "weeding-out circuit" and the circuit containing the receiver are both resonant to the periodicity n, so that for persistent trains of waves of that periodicty the energy of the oscillations set up in the vertical oscillator is transmitted directly to the receiver, but persistent trains of waves of other frequencies, either produce but slight response in the vertical oscillator or else produce oscillations of the periodicity n'', or of a periodicity slightly higher than n_3''. To such periodicty the "weeding-out circuit" and the circuit containing the receiver are extremely irresponsive so that the receiving device receives but an inappreciable amount of the energy of the waves.

In the case of impulsive waves the vertical wire tends to respond only to its own natural rates of vibration as affected by the loop circuit, that is to say, it tends to oscillate at periodicity n'' and to upper harmonics. Such waves acting on the vertical wire, have little tendency to develop oscillations of the natural period of the loop circuit as affected by its connection with the vertical wire, namely n, and the receiver is, therefore, also protected from the effects of such impulsive waves.

All that has been said regarding the effects of electstatic and magnetic hysteresis in the description of the transmitting station applies with added force to the apparatus at the receiving station. It is, in fact, much more important to exclude the effects of hysteresis from the receiving circuits than from the transmitting circuits, and it may be laid down as an important rule that under no circumstances shall solid or liquid dielectrics be used in the receiving circuits.

Moreover, the injunction in regard to making the mutual inductance small between oscillators at the transmitting station applies in the case of the resonant circuits at the receiving station, since if the mutual energies of the related resonant circuits be not small compared to their self energies, the resonant circuits will modify one another's natural periods and each circuit will respond to more than one periodicity.

So great is the selectivity of resonant circuits constructed of air condensers and properly designed coils that there is no difficulty in adjusting such circuits to resonance for a given frequency with an error of less than one part in 3000.

The importance of the "weeding-out circuit" at the receiving station becomes apparent when we observe that the selectivity of the vertical oscillator is greatly diminished by the dissipation of energy, which results from the reradiation of energy by that oscillator and that the selectivity of the resonant circuit containing the receiver may be greatly diminished by the energy absorbed by the receiver and utilized in its operation——"Electrical Review."

A writer in a current issue of a contemporary, states that the ordinary acid solutions should not be used as a flux in soldering electrical connections. The acid solutions will attack the insulation if they come in contact with it. A non-corrosive flux can be made by dissolving rosin in alcohol.

A SIMPLE "WIRELESS" OUTFIT.

CHARLES D. HORTON.

There is something mysterious about wireless telegraphy. It appears to the uninitiated as a magical art; a science unfathomable except to a few whose researches have given them understanding not shared by the average student.

Amateurs in years past have found in the telegraph and the telephone an unlimited amount of pleasure. The construction of transmitter and receivers, the building of the line from house to house, and the subsequent operation of the outfit is bright in the memory of hundreds who now hold responsible positions in the electrical business world.

Not long ago a prominent electrical contractor, becoming reminiscent of his amateur days, said to me, "In my boyhood days we cherished the hope of becoming high in the ranks. We wrote E. E. after our names in the school text-books, and printed letter heads on small hand presses, upon which to correspond with each other. We constructed telephones, both acoustic and electric, and strung telegraph lines across nearly every street in town. But as I think over the past, I realize the immense amount of fun we youngsters lost because wireless telegraphy had not come into existence.

I believe every young man should study the subject and make all the experiments his means will allow. For the young man who takes the study seriously there is a bright future. There is no question but what it is the coming thing, and how soon it will be established universally depends upon the energies of the young men of today."

An amateur outfit of wireless telegraphy in the country or city, should prove a source of much pleasure and profit during the coming months. It is not as expensive as wire telegraphy, which requires relays, sounders and other apparatus, together with wire, which is a leading and heavy expense if a line of any length is constructed.

For a distance of a mile or two no elaborate apparatus is needed, as the sending end comprises a simple key, a few dry cells and a small spark coil, giving about a half-inch spark. The receiving end requires only the purchase of a telephone receiver and a few incidentals, such as a stock of carbon and a few steel needles, etc.

Amateurs may find a detailed description of small coils suitable for wireless sending in back numbers of AMATEUR WORK, and bearing in mind that for short distances of a mile or so a large spark is not a requirement, the expense of construction may be cut down to a very small amount. A spark of one half-inch will serve admirably if care is taken in constructing the receiving end.

In recent experiments I have made over short distances, I have not noted any marked degree of superiority where aerial wires have been carried to extreme heights. I found that a small length of magnet wire, supported on porcelain knobs, from peak of house to the first floor, sufficed for the aerial wire, and for a ground plate I drove several long iron rods into the moist earth and connected same together at the tops. I purchased my key of a telegraph supply house for 30 cents, it being listed as a "strap key." I made a small coil which would give a $\frac{1}{2}$-in. to $\frac{3}{4}$-in. spark, according to battery power. For Leyden jars I followed instructions found in a back number of AMATEUR WORK, using two glass tumblers instead of one larger jar. When the coil key and wiring were connected and one side of the spark gap connected to the aerial and the other to the earth, I was able to radiate enough energy into the air and earth to send distinct messages from one end of the village to the other. Fig. 1 shows a diagram of transmitter connections.

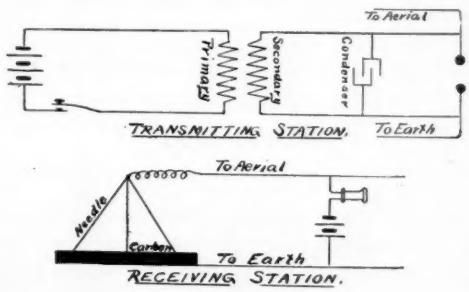


Fig. 2 illustrates the receiving end. The receiver consists of a tripod of three needles with a coil of finest copper wire connected to the top and connected to the aerial binding post. This tripod rests on a small slab or block of carbon, selected for its smooth surface, and this carbon block is connected to the earth. A weak cell of dry battery and the telephone receiver are connected to bridge the tripod and carbon. A choke coil, consisting of a small bundle of iron wires, covered with a hundred turns of fine covered magnet wire was connected between the battery and the telephone receiver. This device greatly improves the signals.

The messages came in long and short distinct buzzes according to the length of time the sending key is depressed. Any code may be used, preferably the American Morse. This outfit seldom gets out of order, and will operate regardless of temperature and other weather conditions, if constructed in a neat manner. It requires no relay, sounders, decoherers and other expensive devices. Improvements, as they suggest themselves, may readily be applied at small cost.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

88 Broad St., Room 522, Boston, Mass.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

Subscription rates for the United States, Canada, Mexico, Cuba, Porto Rico, $1.00 per year.

Single copies of back numbers, 10 cents each.

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New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

MAY, 1905.

Those of our readers who have not a complete file of this magazine, should order at an early date as the snpply of back numbers of volumes I and II is being rapidly exhausted. The present supply is all that can be obtained of these volumes, as the heavy expense of reprinting does not permit of having it done for a whole volume.

When making inquiries through the Correspondence department, be sure and enclose stamp.

BOOKS RECEIVED.

ALTERNATING CURRENT MACHINERY. William Esty, 412 pp., 9½ x 6½. Half seal leather. Price, $3.50. American School of Correspondence, Chicago, Ill. Supplied by AMATEUR WORK.

This book has been prepared with the special object of giving the beginner, as well as the practical electrician, a working knowledge of alternating current apparatus, so that he may know how to install and operate it intelligently. It seems to be a very common opinion that to acquire such knowledge requires an extensive mathematical training, but that such an idea is erroneous, is evident from a perusal of this book, which is clearly and interestingly written and very completely covers the field for which it is intended. It contains no mathematics beyond the simplest trigonometry, and but little of that.

It assumes that the reader has some acquaintance with the simpler laws of electricity and magnetism, the opening chapters presenting the essential features of the source of alternating currents and the alternator, and progressively takes up and explains the various phases of this interesting and important department of electrical work.

MAXWELL'S THEORY AND WIRELESS TELEGRAPHY. Part I. Maxwell's Theory and Hertzian Oscillations, N. Poincare; translated by Frederick K. Vreeland. Part II. The Principles of Wireless Telegraphy. Frederick K. Vreeland. 250 pp., 8¼ x 5¼; Cloth. Price $2.00. McGraw Publishing Co., New York. Supplied by AMATEUR WORK.

The object of this book is to give a physical treatment of theory and its application to some modern electrical problems, to set forth the fundamental principles which underlie all electrical phenomena, according to Maxwell and his school, to show how these principles explain the ordinary facts of electricity and optics, and to derive from them a practical understanding of the essentials of wireless telegraphy.

Mathematics and abstruse reasoning are avoided, making a book which the busy man or student may peruse with interest and profit. While it does not describe all the numerous forms of apparatus now in use, it does present those features necessary to a practical knowledge of the subject, and in such a clear and interesting way as to make the book of the utmost value to those desirous of studying the underlying principles of this important field of electrical research.

PRACTICAL ELECTRICITY. W. E. Ayrton. 642 pp. 7 x 5 in. Cloth. Price $2.00. Cassell & Co., Ltd. London and New York. Supplied by AMATEUR WORK.

It is not necessary to mention this book to any electrical engineer; it is a constant reference book to all, and is so complete and contains so much of value to every day work that it cannot be too highly recommended. No student of electricity can invest in a book which will be of more practical value than this; we cannot speak too highly of it. Its special field is that of experimental and testing work with instruments, which is treated with great fulness. It is just the book for amateurs who have progressed beyond first principles.

MANUAL OF MECHANICAL DRAWING. Philip D. Johnston, 150 pp., including 69 plates, 9½ x 7½. Cloth. Price $2.00. David Williams Co., New York. Supplied by AMATEUR WORK.

This book meets to the fullest extent what, in our judgment, should be included in a text book upon this subject, and should be cordially welcomed by instructors. The exercises are in accord with modern drawing-room practice, the part devoted to geometry and projection is complete without being tiresome, and the studies in machines include a vertical steam engine with detail of parts. A student who would faithfully pursue this course of instruction would be able to do work which would meet the approval of a pretty exacting head of the drafting room.

Renew your subscription before you forget it.

THE METAL WORKING LATHE AND ITS USES.

ROBERT GIBSON GRISWOLD.

I. Description of the Lathe.

Without exception, the screw-cutting lathe is the most universal machine tool that we have. Especially is this so when fitted out with various attachments for performing many operations usually assigned to the milling machine. This universality is not alone inherent with the design of the lathe, but it comes largely from the methods of design used in machine construction. It is far easier to turn a shaft to a cylindrical form than to make it square, or of other geometrical section, although a shaft of such a shape would answer the purpose quite as well in many cases. Of course, in such cases as that in which a shaft is provided with a journal turning in a bearing, it is imperative that the section be circular.

Nor does the limit of work end with the turning of pieces between the centers. The face plate aids in the performance of numberless jobs which, for the sake of speed, are assigned to either the shaper, planer or milling machine. But their work is no more accurate than what can be done on the face plate in facing the sides of a piece to absolute parallelism. Provided the face plate is true and the slide rest is absolutely parallel with it, delicate operations may be performed in this manner with ease and speed.

A great many lathes, especially the smaller sizes adapted for the use of amateurs, are fitted with milling attachments which widens the scope of the lathe still more. Gears, both of the spur and bevel variety may

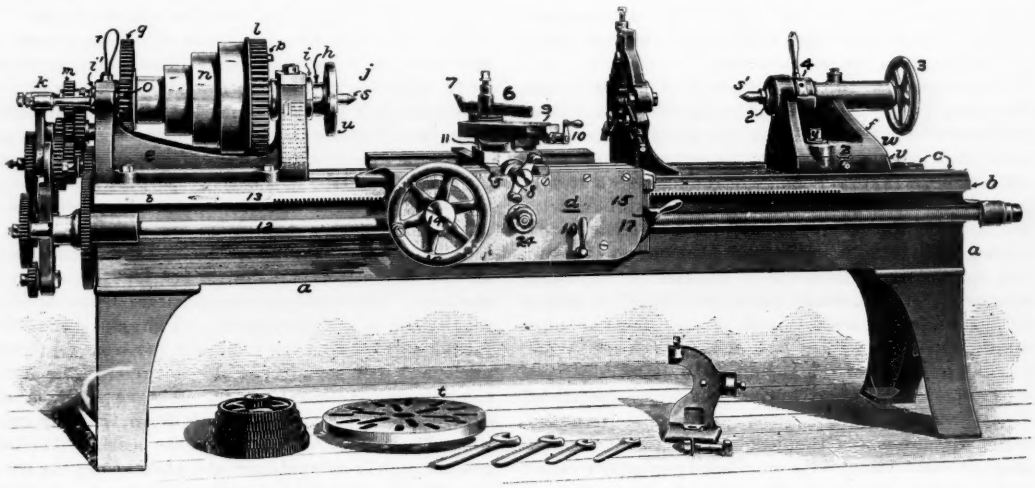


FIGURE 1. METAL WORKING LATHE.

The vast field of thread cutting is easily covered by the modern screw-cutting lathes, and threads of every conceivable section are readily cut. Nor is it uncommon to see the formation of a spiral groove, which in reality forms a thread, cut across the face of a piece of work. Threads may be readily formed on the conical surface of a piece, and in a great many cases threads are cut on worms for the transmission of power when the contour of the worm is far from a straight line.

By the aid of special forming cams attached either to the cross-feed screw or elsewhere, certain predetermined shapes may be formed from solid blank material, and in repetition, with the assurance that each will be an exact duplicate of every other.

be readily cut, while cutters, reamers, and other special forms may be made.

The tool carriage may be easily fitted with a saddle upon which cylinders may be strapped and by the aid of a boring bar swung between the centers, bored to a true cylindrical surface, the feed of the carriage moving the work to the cutter. In this respect it occupies the place of the horizontal boring mill, while the shaper milling machine and drill press are each divisted of certain lines of work usually assigned to them as belonging to their particular field.

It is the intention to treat in these articles the various operations that may be performed on the lathe, as well as the other machine tools in common use in the

shop. The various parts of the lathe, its construction and method of operation will first be considered.

As it will be impossible to cover in the space available, every type of American lathes, a representative will be taken that lies midway between the very large and the small machines, and one that is not provided with all the new change gear features of convenience will be described at some future time. Fig. 1 shows very clearly such a lathe, and the letters of reference indicate the various parts to be spoken of in detail.

The bed of the lathe, a, is one of the most important features. While it does not appear at first sight to require any very great skill to make a metal form that will support and guide the carriage, a more intimate study of its construction will show many points where cheap lathes "fall down" when the test of heavy work is applied. The heavier the bed the greater solidity given to the machine, but not necessarily stiffness, which is purely a point of design. When a piece is supported between centers and revolved rapidly, as is usually the case in finishing the surface with emery and oil, any irregularity of form will cause a serious pull from from one side to the other, due to the centrifugal force. This pull will soon set up a vibration in the machine if it is light, that is annoying and apt to throw the parts out of alignment.

The strength of the bed is alone a feature of design. They are usually made of the box-girder form, similar to that shown in Fig. 1, the two sides being tied together at frequent intervals by the struts cast integrally with them. There is a flange at the top and bottom of each side which gives lateral stiffness, and upon the top flange the carriage usually moves. Great care is necessary in the casting of these beds to see that during the cooling of the metal, no unnecessary shrinkage strains are set up, which, after the "skin" is planed off, will cause a distortion that may in time grow worse.

The upper side of the top flange, b, is usually made with one or two, (two in the best forms) inverted V ridges, which form the ways, c, upon which the carriage, d, moves, and the headstock, e, and the tailstock, f, rest. These ways are planed perfectly straight and true, and they form the guide for the tool, and, unless they are in perfect truth, the work will not be straight. In some forms of lathes there are no ways on the rear top flange, the carriage resting on the flat surface. One point of argument in support of this method is that the expansion of the struts has no tendency to lift the carriage and cause it to run on one side only of the the two Vs.

The greatest wear on these ways naturally takes place near the headstock, while that portion towards the tailstock end may not be worn in the least. Of course the majority of the work is short and the movements of the carriage are greatest at this point. The best makes of lathes provides an extra long bearing for the carriage, which obviates this difficulty to a great extent. There is now on the market a new tool-steel way that may be attached to a lathe bed. This may be renewed when worn and, since it can be hardened, greatly lengthens the life of the lathe within accurate limits, although there are few lathes that will outwear the ordinary cast iron ways. By the time they have served their period of usefulness, every bearing and gear has become badly worn.

It should be cited that two sets of ways are frequently provided for this reason; the head and tail stocks are mounted on one set, which are never worn to any extent and therefore always remain in line and true, while the carriage travels on the other set, in which the wear is evident, but, since it is in a vertical direction to a great extent, the point of the tool does not travel very far from a straight line parallel with the centers.

The headstock, e, is bolted firmly to the bed, generally resting on one of two sets of Vs. This stock carries the spindle, h, which runs in the bearings, i and i. The spindle is usually hollow to admit of rod stock being run through it to a chuck. The end at j is provided with threads and a shoulder against which the various pieces may jamb when screwed into place. The thrust of the work and tool against the spindle is taken up either by a thrust bearing surrounding the spindle at the back end, or by a yoke and thrust screw, as shown at k. This screw is also provided with an axial hole through which rod stock may be passed. This form, however, is rapidly being supplanted, especially in the smaller forms, and it is rarely seen except in some very large lathes. It has many points of advantage, however, and leaves the bearings of the spindle free of all thrust loads.

The spindle should be as heavy as convenient, and should be supported in large bearings, especially at the head. This bearing, i, takes all the inducing chatter. Then, again, this bearing is largely responsible for the alignment of the lathe and any wear that takes place here will soon throw the entire machine out of commission for accurate work. It is very seldom, except in cases where the belt pulls down, that any great wear occurs in the bottom half of the bearing. The belt generally pulls upwards and the tool thrusts the work upwards so that the top half of the bearing receives most of the wear. The bearing at the opposite end of the spindle is not subject to such great strains and, therefore, does not wear rapidly. The spindle, m, carries two gears in most cases, a large one, l, at the head end, and a small one, m, at the opposite end. The gear, l, is invariably keyed securely to the spindle, as the latter is driven by it at all times.

Mounted upon this spindle is the cone-pulley, n, to the small end of which is keyed a small pinion, o. This cone is free to revolve upon the spindle, and can be rigidly connected to the spindle only by means of a sliding bolt at p. This sliding bolt takes different forms; in some instances it is made to push in or pull out, and is then very convenient. With the ordinary bolt a wrench is necessary, and by sliding it in or out

of a notch in the inner periphery of the cone, a positive driving connection is made.

Owing to the fact that the countershaft turns at a constant speed, it becomes necessary to have some device whereby the speed of the spindle may be altered at will. As the diameter of the work increases, the speed will have to be reduced to maintain the cutting speed found best for that material. In order that this end may be readily accomplished, two opposed cone pulleys are used and so arranged that the largest step of one drives onto the smallest step of the other. By this method, the mere shifting of the belt from one step to another will give quite a variation of speed. Many of the light lathes and most all speed lathes are fitted with this cone only, but in lathes intended for heavy service and a greater range of work, it becomes necessary to provide more changes in speed, and to this end another spindle carrying a large and small gear is supported directly behind the main spindle. The large gear, q, meshes with the small pinion, o, and the smaller pinion on the "back-gear" shaf t meshes with the gear, I. These gears may be thrown in or out of mesh by means of a small eccentric journal on the end of a shaft, and this shaft is turned by means of a small handle, r.

The ratio of these back-gears is such that the same arithmetical proportion is preserved throughout the entire series of belt positions and, as in the case of the lathe shown, there would be four speeds with the cone connected directly to the gear, l, and four slower speeds with the back gears thrown in. Of course the bolt, p, must be withdrawn from its slot when the back gears are thrown into mesh.

The end, h, is shown in Fig. 1, carrying a small driver plate, which is provided with one or more slots into which the tail of a "carrier" or "dog" enters, so that the motion of the spindle may be transmitted to the work, being turned on the centers, s and s′. A large face-plate, t, is also provided, which screws onto the spindle, in place of the small carrier plate, u. Chucks and other fixtures may be fitted to this threaded end.

At this point it may be well to give a few words of caution regarding the use and abuse of this thread. Too many lathe hands are careless in this respect, and it is a vital point in any lathe. In the first place, before screwing any fixture onto the spindle, see that the threads are perfectly clean; wipe them out with a little oil on a piece of waste, using a small stick of wood instead of any metal to force the waste into the groove. Then be equally sure that the thread in the face-plate, chuck or carrier is equally clean; also that the seat against which these parts rest are clean, as a small chip may throw any one of them out of alignment. When any one of them is put away, be sure to fill the threaded hole full of cotton waste which will keep out all dirt. If the pieces are to be hung up, use a wooden peg rather than one of metal, as the latter mars the threads. Thus, with careful use, the fit of these attachments to the lathe spindle should remain accurate for years.

The tail-stock, f, is usually made in two pieces; a v, and the head, w. The base v is fitted to the inner set Vs in a manner similar to that used in the headstock, except that it is free to move from one end of the lathe to the other. It is clamped in any particular position by means of the bolt, y, which passes into a clamping yoke beneath the upper flanges.

The head, w, is fitted to the base by means of a tongue-and-groove joint, z, which insures perfect parallelism, no matter what positions the two parts assume. A small screw, l, serves to move the parts from one side to the other. This lateral movement is provided in order that tapers may be turned. The tail-stock is set to one side of the center line, and since the tool moves in a straight line, it will gradually approach nearer to one center than the other, thus making a gradual reduction in the diameter of the piece being turned. In many of the modern lathes this is rendered unnecessary by a taper attatchment fixed to the back of the lathe. It is simply a grooved piece so supported that it may be set at any angle, within small limits, with the centerline of the lathe. In this groove slides a block to which is attached the tool-post block. The tool is therefore constrained to move in a line at a definite angle with the axis of the work which forms the taper. This attachment is far superior to the method of setting over the tail-center, as the work revolves upon a perfectly fitted cone, and not on one side of it. As a general rule, a more abrupt taper may be turned with this attachment, and it is especially handy when the taper occurs in the middle of a long piece, as it then becomes very difficult to set the tail-stock over far enough.

This stock also carries a spindle, called the "tail-spindle" the end of which is shown at 2. This spindle is free to move in a longitudinal direction, but a key in the stock barrel prevents its rotation. A taper socket is provided which accommodates the center s′ or another attachment that may be desired. A hand-wheel, serves to move the spindle in or out, and it is clamped in position by some such device as the cam, 4, or a clamping screw. As there is little movement in this spindle, it does not wear to any great extent. It should be very solid, however, as lack of rigidity at this point will quickly induce chattering.

The tool carriage next claims our attention. The carriage proper rests upon the outer set of Vs, and is provided with very long bearings so that the wear may be reduced to a minimum. The bridge connecting the two bearings is provided with Vs, 5, upon which the tool block, 6, is mounted. This block, which carries the tool, 7, is moved by the screw, 8, of which only the handle is visible. A modification that is often made made of the plain rest is that shown in Fig. 1 and known as the compound rest. It is simply another slide mounted on the tool block, the slide, 9, being moved by the screw, 10. This slide may be set at any

angle and the tool thus fed to the work along any line at any angle to the plane of the face-plate or center-line of the lathe. It is almost indispensable in a general line of work, as tapered holes may be bored with it and very short tapers turned. The base, 11, is generally provided with a graduated arc by means of which the exact angle being turned may be determined.

The carriage is fed along the ways by means of a feed screw, 12. This screw is driven by gearing in this case, but usually a belt is used, as breakage is often prevented under an overload by the belt slipping. The thread of the screw is seldom, and should never, be used for ordinary feeding, as its purpose is that of thread cutting, and the greater the wear therein the less accurate will be the thread cut. A key-way or "spline" is usually cut throughout the entire length of this screw, into which fits a key in a sleeve surrounding screw 12. The rotation of 12 then turns this sleeve, the periphery of which is provided with a worm thread. This in turn drives a gear that meshes with the rack, 13, and any motion of the gear will cause the carriage to move along the bed. This gear may be thrown in or out at will by the thumb-nut, 14, which controls a friction clutch behind the apron, 15. For ordinary feeding by hand, and rapid movement of the carriage, the hand-wheel, 16, which is connected with the rack-gear by means of an intermediate pinion, is used.

In order that the screw, 12, may be used for thread cutting, a means for attaching the carriage thereto must be provided, and this is accomplished with a spit that closes over the screw by means of the handle, 17. Another set of gears, behind the apron, are thrown into gear by the friction clutch nut, 24, and feed the tool across the carriage, giving what is known as automatic cross feed. A lever, 18, is provided on many lathes for reversing the direction of feed at the apron, and is very convenient. Still others incorporate this attachment as a part of the head-stock mechanism.

The matter of the change gear, compound gearing, thread cutting and the use of special attachments will be taken up in later chapters.

HOW TO BUILD A POWER LAUNCH.

CARL H. CLARK.

VI. Installing the Engine.

In choosing the engine, as good a machine should be purchased as the means at hand will allow. Although the four-cycle type is rather more reliable and economical of fuel, almost any of the two-cycle types will be found to give good satisfaction when well installed, and are much simpler and cheaper. An engine of medium weight should be chosen, as being less of a burden, and also, as having a higher rate of revolutions, the vibration will be less—the extremely light type should not, however, be used as the weight of metal is usually not sufficient to stand continued use. As to size, a three h. p. engine will probably do fairly well, but to obtain the best results a 3½ or even 4 h. p. may be made.

It is hardly necessary, in a boat of this size, to use any kind of reversing apparatus, although a reversible propeller is sometimes useful and is quite desirable if a good type be obtained. If the question of cost enters into the matter, the reversing apparatus may easily be dispensed with and a plain shaft and wheel fitted. The fact that most two-cycle engines will run in either direction and may, with sufficient skill, even be reversed will help to decide the question.

The construction of the engine bed has already been described and the engine must now be fitted into place.

A fine wire is passed through the shaft hole, stretched tight, and fastened so that it is in the exact center; this locates the center of the shaft. The engine is now measured to find the exact relation of the bed flanges to the shaft center; they will usually be either in the line of the center or slightly below it. The bed is now trimmed down until it bears the same relation to the wire that the flanges do to the shaft center. The engine is now lifted in place and the propeller shaft passed through and secured in place to the engine coupling. When the engine is correctly set the shaft will be exactly in the center of the hole; it is then fastened into place with lag screws.

The stern bearing should be shipped on to the end of the shaft and fitted to the back side of the sternpost. The latter is trimmed until the bearing bears evenly against it without cramping the shaft. It should be borne in mind that the joint between the bearing and the sternpost must be water tight to prevent leakage into the boat through the shaft hole. The bearing is fastened into place with lag screws, after smearing with white lead. In some makes of engines the stem-bearing is fitted on the inner end of the shaft log, and a plain bearing on the other end; this is the preferable method, as then the gland may be tightened more readily.

The shaft will usually be sent several inches length to spare. One end will be already fitted to the propeller. Careful measurements should be taken and the shaft cut to such a length that there will be sufficient length between the propeller and the bearing, that the cap may be removed and the gland packed without trouble. The propeller is securely fastened to

the shaft by the means provided, the shaft is put into place and the set screws in the coupling set up tight. After this is done the engine should turn freely if everything is properly in line. When the engine is properly set the remaining pieces of floor may be fitted and laid, a suitable opening being left in front of the engine to allow starting with the handle.

The piping may be arranged all on one side of the engine, leaving the other side open for the passage, or if it is desired to have both sides of the engine clear, all pipes may lead directly down from the engine to the floor, and a light guard or slip be fitted over them.

The exhaust piping should be fitted first, as it is the largest and hardest to handle. The muffler should be placed athwartships under the after seat. The openings for pipes on the different makes of engines vary to such a degree that exact directions cannot be given. The exhaust should be piped from the engine to the space under the seat, ending in an ell; from this ell a straight pipe runs aft under the seat and is connected to the muffler with an ell. The exhaust from the muffler passes out through an ell, up and aft and out through the sternboard. A locknut is fitted on the exhaust pipes inside and outside of the stern board to secure tightness. The exhaust pipe should be kept clear of all wood work as far as possible, and whenever this cannot be done the woodwork should be covered with asbestos.

The inlet for the cooling water should be well below the water line. A perfectly tight joint should be secured with lockers and washers inside and outside. It is the common practice to fit a short piece of pipe to the plank and make the remainder of the connection to the engine with a rubber hose; in which case the jar of the engine will not tend to loosen the pipe in the plank and cause a leak. The outlet from the engine should lead out through the side of the boat above the water. The inlet should be covered with a strainer to prevent the sucking in of sand or other material. The joints in the water piping should be made up with red lead to assure tightness.

The pipe from the gasoline tank is best of lead securely soldered to unions at each end. A stop-cock should be fitted on the tank and another at the vaporizer; this will allow the pipe to be disconnected if necessary, without emptying the tank. Great care is necessary to have all the piping connected with the the gasoline absolutely tight. The filling pipe for the tank should extend up through the deck in one piece, leaving no open space through which the gasoline would have to pass, allowing it to generate vapor. The lead gasline pipe should be led in such a manner that it is in no danger of damage, as it is quite soft and easily jammed. Joints in the gasoline pipe should be made up with shellac or soap, as red lead will be eaten out by the gasoline and leaks caused.

If pipe dies are not at hand, the pipe may be taken to a pipe fitter together with careful measurements, and pipe cut by him. The pipe for the exhaust may be of galvanized iron and that for the cooling water of brass.

For ignition two sets of batteries should be used of six each, they should be arranged in a box of requisite size, as shown in Fig. 1. The rows are connected up separately, the zinc of one cell to the carbon of the next, and so on. On one end of the box is fitted the three-pole switch, B, which allows either set to be used as desired, the wires from the carbons of the end cells being connected to the poles of the switch. The zincs of the cells at the other end are connected to one

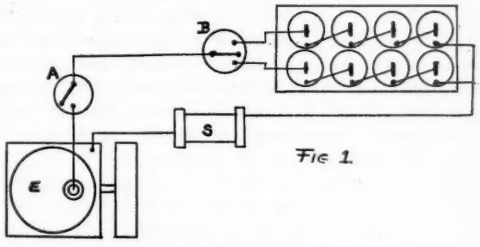


FIG 1.

WIRING DIAGRAM FOR ENGINE.

wire, which leads to one terminal of the spark coil, S. From the other terminal of the coil a wire is led to some part of the engine or piping and a good electrical connection made. From the third point of the battery switch a wire is led to one point of the two-point switch, A, and from the other point of this switch to the insulated electrode of the engine. The switch, A, is placed near the engine and allows the current to be cut off when the engine is not in use. The battery box should be placed in some dry location, together with the coil, which may be fastened to the box if desired. The wiring should be very carefully done, as a large part of gasoline engine troubles are caused by defective electrical outfit. The connections for a jump spark ignition will be much the same, differing principally in the connections at the engine.

When purchasing the engine, the buyer should obtain all the information possible in regard to its installation and operation, as in this way much time and labor may sometimes be saved.

When all the work has been done the final coat of paint should be given and all seams filled with rather soft putty, which will be easily squeezed out when the planks swell. The boat should then be launched.

If the builder is not familiar with gasoline engines it will be well to obtain the services of an experienced person for the trial trip, and the amateur is advised to obtain one of the several good books on this subject and make a study of it so as to familiarize himself with the theory and principles of operation.

During the first few weeks of running, plenty of lubricating oil should be used until the various bearings become smoothed down to a good wearing surface, and care should be taken that no grit or other material finds its way into them to cut them out.

With proper care both engine and boat should last for several years with only minor repairs.

The hull should be smoothed up after two or three months and another coat of paint applied. All varnished work should also be kept well covered during the first year to avoid cracks and checks while the wood is setting into place. It is hoped that with these instructions the amateur will be able to construct an able and satisfactory boat, and one which will give pleasure to himself and his friends for many years.

SECONDARY TECHNICAL EDUCATION.

Secondary technical education has come to mean that instruction in technical schools which stand midway between the engineering college course and the trade school course. It consists of study and practical work combined, with the object of giving a thorough grounding in the principles and main facts of engineering, and to supplement this with application of these facts and principles to actual work.

Technical education in this country has, so far, been largely confined to the development of purely engineering courses, fitting the student for design and supervision of installation of railroad, power plant machine shop or what not, and incidentally giving some idea of the actual work required in carrying out these designs and installations.

Considered from an economic standpoint, time and energy spent in completing an engineering course by the man whose natural ability and instinct fit him for a position in charge of actual construction work is out of proportion to the necessities of the case. To complete an engineering course in a good college requires, before entrance, the completion of at least a full high school course, and four years in the college. To the student of ordinary mental ability, this means that his ctua life work cannot be commenced much under the age of 23 years. While this may not be a burdensome matter for many of those who contemplate engineering as a life work it, nevertheless, bars from a technical school education many young men who have in them the making of first-rate foremen and superintendents.

In a recent address delivered before the Schoolmasters' Club of Denver, Victor C. Alderson, president of the Colorado School of Mines, called attention to the industrial strength which has been achieved by Switzerland in spite of unfavorable conditions by the system of detail instruction in industries. This system extends from the Polytechnic School at Zurich, which is one of the finest in the world, through all grades of instruction down to a traveling school for shoemakers which goes from place to place instructing the peasants in the art. In all the courses of all of these schools, science, art, literature and language are studied, but simply as a means to the industrial end.

In treating all subjects on this basis, it is not necessary that they should lose their value as mental training, or their influence to broaden the student. All that is needful is that studies should be so chosen and related to each other that the utilitarian value of each shall be brought out to the greatest possible degree. In France, the National Institute of Art and Trade stands at the head of the system of technical education which includes instruction in commerce—by both high school and college courses; in foremanship, by a system of four schools giving secondary technical instruction; special schools in wood and iron industries, in watch making, in weaving, modeling, cabinet making, machine shop practice and gun making. Besides the national system, many cities have special schools of their own for teaching trades and arts.

English cities and philanthropists are establishing technical schools for day, and especially for evening students, largely of secondary technical grade, but no national sysiem is organized.

German industrial schools are models to be envied and followed. From the primary schools all students pass to trade schools of all industries for both boys and girls, and to secondary schools of technics and commerce. Above these are the higher engineering schools standing beside the great universities which are devoted to literature and pure science. As a consequence, Germany has developed an industrial system which has turned the empire into a vast workshop and placed it in the front rank of manufacturing nations in spite of unfavorable conditions and the somewhat phlegmatic temperament of the people.

As a nation, we are industrially successful, but are we as successful as we might be, if our workmen, our foremen, our superintendents, were all trained to utilize their abilities to the best advantage? Engineering colleges are doing a splendid work, but from observation of the occupations of technical graduates, it would appear that these colleges are at present turning out as large a supply of designing engineers as the industries of the country can use. On the other hand, the only source from which men can at present be drawn for intermediate positions in manufarturing systems—which has a course not intended to train for such work—or the rank and file of the workmen.—"The Engineer."

The temperature attained by the burning gases in the combustion chamber of a gasoline motor cylinder, at the moment of explosion, is in the neighborhood of 3000° Fahr., while the temperature of the exhaust is from 700 to 900°.

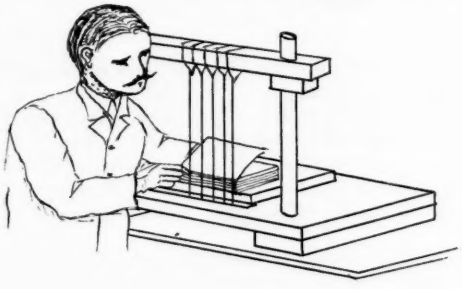
BOOK-BINDING FOR AMATEURS.

WINTHROP C. PEABODY.

V. Stitching the Book.

The books having been arranged and placed as described in the previous chapter, they are then ready for the important operation of sawing and sewing. The book or books are evenly "jogged" on the back to bring that surface perfectly flat, using care that, in doing this, the top register is not broken. Press boards are then placed outside, with the edges at the back about ⅛ in. from the back of the book. The book and containing boards are then placed in the laying press or, in the absence of this tool, in a vise or between cabinet makers' clamps tightly screwed up to prevent movement during the sawing of the sewing kerfs or slots on the back.

Before sawing the kerfs they should be spaced off and plainly marked with a pencil, using an ordinary carpenter's square so that they may be accurate. For



POSITION FOR SEWING.

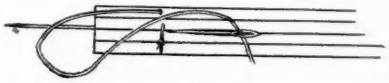
all except the largest books, five cords will answer. Begin by marking with a pencil the place for the cut at the head or top of the book, which should be about ¾ in. from the top edge when trimmed. The one at the tail, or bottom of the book, should be about 1 in. from the edge; then cuts about ¾ in. inside of each of these two; then another at the center between the two already made, and one each central between the center one and those at the ends, making seven in all. The two cuts nearest the ends are for the "kettle" stitches and do not have cords, so are made only deep enough to enable the sewing needle to be put through without difficulty. Kerfs are then sawed with a back-saw at the places marked, to a depth of about 1-16 in., varying slightly with the size of cord used in the sewing frame. With large, heavy books it may be necessary to enlarge the kerfs by canting the saw first to one side and then to the other, in this way getting a wider cut than would be made by the saw in a vertical position.

The next operation is that of sewing. A sewing frame of the kind described in the September, 1902 issue of AMATEUR WORK, is threaded with cord, one for each kerf. These cords should be of the best quality hemp, and obtainable of dealers in cord and twine. At the same time get the sewing twine, which should be an unbleached linen twine, smooth and strong. The size will largely depend on the thickness of the signatures comprising the book being sewed; if the signatures are thick, as would be the case with AMATEUR WORK, a strong, rather large twine should be used, but for thin signatures of eight to twelve pages, a smaller one is best. A little experience and the examination of a well bound volume of a size similar to those in hand, will show the correct size to use.

STITCHING WITH FIVE CORDS.

The cords in the sewing frame are first tied at the lower ends to short, flat pieces of wood which span the opening through which the cords are brought up to the cross bar at the top. The upper ends are carried twice around the bar and tied with a slip knot, using care to have all of an even tension.

The back of the book is then placed against those cords, which are moved along until they are in the right place to fit into the kerfs. The cords are then tightened by turning the nuts under the cross bar, until the cords are sufficiently tight to prevent being moved from the proper places during stitching. It is desirable to place the cords as far to the right



TYING AT THE ENDS.

of the frame as possible to give room for the arms in sewing. A strip of wood should also be placed in the opening in the table to prevent the cords from moving forward under the pressure of the book as the sewing proceeds. A pressing board is then laid upon the table with one edge flush against the cords.

The book is then laid upon the bench to the left of and near the sewing frame, with the fore edge to the front and title page at the top. The first signature is

then lifted, turned over to face downward, and partly opened at the center by placing the first two fingers therein and pressing with the thumb to keep the leaves from slipping apart, and placed against the cords where the kerfs have been cut.

A needle, single threaded, with about a yard of the sewing twine is then put through the kerf at the left, taken by the left hand and put through the nearest kerf containing a cord and to the nearest side of the latter, and drawn out until only about three inches of twine extends from the first kerf. The needle is then returned through the same or second kerf, but on the other side of the cord, carried to the next kerf, out and around the cord there, and so on to the kerf containing the last cord. After being carried around this last cord it is brought out through the remaining kerf, drawn taut but not too tight, and another signature is then placed in position. The sewing is then repeated, but in the reverse direction, and upon reaching the (first) end kerf, is knotted to the projecting end just underneath. Another signature is then added, the sewing proceeds as with the first one; another signature brings the sewing back to the starting kerf again. On reaching the end kerf of every signature after the second, the needle is passed between the two signatures immediately under it, knotted with a slip knot drawn tightly into place. This is done at each end. As sewing proceeds it will probably be necessary with all except very thin books, to occasionally press the signatures down with an ivory, so that the subsequent "backing" will not disclose loose stitching. A strong double knot is made with the end of the last signature and the end cut off, leaving enough to prevent untying. When one needleful has been used, another length of twine is tied on, making the sewing twine practically one continuous length. When the sewing is completed the cords are cut off, leaving about two inches on either side.

PHOTOGRAPHY.

WHY? - SOME BEGINNERS QUESTIONS ANTICIPATED AND ANSWERED.

T. THORNE BAKER.

If for the term "why and wherefore", we had substituted the word "chemistry," the beginner would very likely have passed over this article, thinking it altogether beyond his ken. It is not, then, to be chemistry at all, but merely a simple chapter on the reasons for doing as we do in development, and, in order to make it quite seasonable, it shall deal exclusively with the development of lantern plates and bromide and slow contact, or "gaslight papers.

It would be quite possible to lay down a vast series of laws, of what to do in development, what to avoid doing, and what steps to take in various cases, so that an amateur photographer who could bear them all in mind and put them into use would be capable of dealing with any emergency. But if, right from the start of photographic work, the amateur would ask the question, what is he doing, and why, and thus understand a reason for every action, the time would very rapidly come when his own knowledge of the "Why and Wherefore" would enable him to cope with all difficulties without troubling a friend, textbook or all-patient Editor for information.

Development, when considered seriously, is a remarkable thing, and must arouse curiosity in the mind of every photographer at some time or other. It requires little thought, however, to see that the developing solution turns the film of a plate or piece of bromide paper black wherever the light has acted upon it, *i. e.*, wherever it has "seen" the light.

A piece of P. O. P., if put into some developer, will turn black almost immediately, whether it has "seen" the light or not, and this behavior is characteristic of every brand of printing-out paper which requires the continued action of daylight to print it to sufficient depth.

A lantern plate is a piece of glass, coated on one side with a mixture of gelatine and a cream colored substance called silver bromide; the same mixture is used for bromide papers. In some makes other substances are, of course, used as well, but silver bromide will be sufficient for our purpose here. During the exposure of a lantern plate behind a negative, a physical change quite invisible to the eye takes place in every portion of the film where the light is able to reach it; thus the black portions of the negatives or "high lights," do not allow light to reach the lantern plate film, while the light can pass freely through the clear portions or "shadows" of the negative, and thereby produce the physical change already referred to. The nature of this change is too complex to be discussed here, and hence only its consequences need interest us.

Suppose that now we place an exposed lantern plate in some developing solution and watch the progress of development. First of all, the developer consists of, let us say, hydroquinone and soda, originally in two solutions, A and B. A consisted of the hydroquinone in water, together with some preservative, such as sodium sulphite, and B of caustic soda in water; in the

mixed developer, therefore, we have all these things, and always a little bromide as well.

The change that took place during exposure has made the following difference in the film: Wherever the light got through a clear portion of the negative exposure and reached the plate, the film will begin to turn black, whilst the protected parts will not be in any way altered. If no caustic soda or alkali were present, the development would proceed very slowly; the soda, however, neutralizes, or "kills" this acid, and the more we put in the developer the quicker does it act, and the result is that the dark parts of the image become sufficiently developed before the half tones or delicate portions are of sufficient depth or density. Thus it is necessary to adjust the proportion of soda to hydro-quinone, or carbonate to metol or whatever it may be (in general "alkali" to "reducer"), with precision; hence the necessity for a reliable formula.

A lantern plate or bromide paper developer must contain the following parts: the developer itself, such as hydroquinone; the preservative, such as sodium sulphite; the alkali, such as sodium carbonate; the solvent, water; and, finally, what we may discreetly term the safety-valve, potassium bromide. Our bottle of ten per cent bromide solution is an all-powerful lever; it ensures purity in the whites, it regulates contrast, and is in every way a necessary thing.

Bromide is such an important thing, in fact, that we had better just see how and why it works. A sheet of gaslight paper, unexposed to light, should be left in a metol-hydroquinone developer, and another, sheet in a similar developer, only to which several drops of ten per cent. bromide solution have been added, for the same time—say one minute. On then examining them, it will be found that the piece developed in the presence of the extra bromide is infinitely cleaner or "whiter" than the other. This experiment alone teaches us two things: First, that the paper will fog, or turn discolored, even if it has no exposure, on prolonged development; second, that the fog produced by the developer is prevented by bromide, at any rate, to some extent. We are thus taught the following:

1. Never leave a lantern plate or piece of development paper in the developer longer than is necessary.
2. If the whites do not seem pure, add an extra drop or two of bromide solution to the developer.

It also follows from what we have said that too much bromide in the developer will destroy the softest gradation, and give us very clean but very harsh pictures.

That the amount of carbonate or caustic in a developer must be accurately arranged, has already been pointed out, and this is not only because a developer such as hydroquinone requires a specific quantity. but also, since the amount varies very considerably with different developing agents. Amidol, for instance, does not require any alkali at all, and the best formula is made up thus:

Sulphite of soda	10 parts.
Water	100 "
Amidol	1 "

Here, again, the amount of amidol may be varied; more amidol gives greater density, less gives less, just as if an alkali were present; the bromide, too, must be present, in order to ensure cleanliness.

When development is finished, we have a black image consisting of decomposed bromide of silver resting on, and in, the original creamy white film. It is obvious that this unused substance must be removed, and we therefore put the plate or paper into a "fixing" bath which dissolves away any silver bromide not affected by light during the exposure. Remember that the ordinary light should never be turned on in the dark-room, nor the plate removed from the red light until thorough fixing of a lantern plate or rapid bromide paper is accomplished.

As hypo dissolves the white silver salts, it is at once evident how careful we must be not to allow any fixing solution to drop into the developer. The more we know of the action of our various chemicals, the greater need we shall see of cleanliness.—"Amateur Photographer."

PHOTOGRAPHIC NOTES.

Twenty years ago, said Dr. Hollingsworth, it was a common practice to over expose, whereas, nowadays, with beginners, at least, it seems to be nothing but hand cameras and under exposure, and it seems unfortunate that the most difficult process of exposure should come first.

With a negative that is technically good we can do almost anything, but if we get a defective one it is only by dodging, and experience at that, we can overcome its defects. Under and over exposure teaches us that there are limitations within which exposure lies, and that it takes time for the light to impress the image upon the plate.

In taking photographs we have to deal with or consider, a number of factors. Some of these take the form of atmosphere, wind, fogs, varying conditions of lighting, the summer or winter, and the difference in the actinic value of the light brought about by the changes of the seasons, and, finally, with the important matter of the subject itself.

Then, again, many beginners do not find out for a long time the value of the stops, though this has a great deal to do with the length of the exposure and the results obtained. It should be understood that each one, as we work down, practically doubles the exposure. In focussing at open aperture (which is the correct method) it is best to aim at sharpening up any object about a third of the distance away, and then to stop only sufficient to bring the whole field of view into equal focus.

There is also the question of fast plates and slow

ones. The tyro generally uses the former, although the latter are the most easy to control. The fast makes are more easily damaged by fog in the dark room, owing to the unnecessary and continuous practice of frequently looking through the plate to see how development is going on.

There is a golden rule—expose for shadows, and the rest will take care of themselves, which each must always bear in mind if he wants to make the negative a successful one.

The use of an actinometer was strongly recommended, so that some guide may be followed. It will save its cost over and over during a busy season.

Metol seemed to have the faculty of bringing out detail before it piles up density. With it one has to take the plate further than seems to be necessary, as it looses a good deal of density during fixation.

It is most important, if one wants to do good work to stick to one developer and master it before one makes any change. The same rule applies equally to the plate. We should thoroughly understand one particular kind, exhaust its possibilities, instead of flirting about from one to another. If this is followed out, the more experience one gets the more will he find that one make is perhaps as good as another and capable of producing good negatives if the exposure and development are correct.

A French photographer, M. G. A. Liebert, has recently devised an apparatus which will enable him to take instantaneous photographs in his studio. This device is described in *Le Revue Patrique de l'Electricite* for December 5. The object of using electric lights is to give the photographer entire control of the quality and amount of illumination and to render him independent of daylight. Moreover, to obtain the best portraits it is very desirable that they should be taken instantaneously and at the moment when the subject is in the best pose.

The device consists of a large parabolic reflector of aluminum, having placed on its inner edge a series of incandescent lamps shaded with ground glass screens. The object of these is merely to light up the subject, permitting the photographer to secure the best pose and to determine when the real exposure should be made. At the center of this reflector is an arc lamp with three carbons. One of these is fixed and the other two are moveable. When a photograph is to be taken, the subject is arranged and the sensitive plate is exposed. The photographer then waits until a desirable pose has been secured, when he presses a rubber bulb, which draws the two movable arc light carbons across the fixed one, thus forming a brilliant arc; but the moment the current passes through the lamp the movable carbons are drawn away from the fixed one by means of an electromagnet, and the arc is thus extinguished. It lasts about one-fiftieth of a second, but this gives sufficient time for an exposure.

WIRE GAUGE TABLE.

By Courtesy of Brown & Sharpe Mfg. Co.

DIFFERENT STANDARDS FOR WIRE GAUGE IN USE IN THE UNITED STATES.

Dimensions of Sizes in Decimal Parts of an Inch.

Number of Wire Gauge.	American or Brown & Sharpe.	Birmingham, or Stubs' Wire.	Washburn & Moen Mfg. Co. Worcester, Ms.	Imperial Wire Gauge.	Stubs' Steel Wire.	U. S. Stand. for Plate.	Number of Wire Gauge.
000000	.....	.....	.....	.464	.....	.46875	000000
00000	.....	.....	.....	.432	.....	.4375	00000
0000	.46	.454	.3938	.400	.....	.40625	0000
000	.40964	.425	.3625	.372	.....	.375	000
00	.3648	.38	.3310	.348	.....	.34375	00
0	.32486	.34	.3065	.324	.....	.3125	0
1	.2893	.3	.2830	.300	.227	.28125	1
2	.25763	.284	.2625	.276	.219	.265625	2
3	.22942	.259	.2437	.252	.212	.25	3
4	.20431	.238	.2253	.232	.207	.234375	4
5	.18194	.22	.2070	.212	.204	.21875	5
6	.16202	.203	.1920	.192	.201	.203125	6
7	.14428	.18	.1770	.176	.199	.1875	7
8	.12849	.165	.1620	.160	.197	.171875	8
9	.11443	.148	.1483	.144	.194	.15625	9
10	.10189	.134	.1350	.128	.191	.140625	10
11	.090742	.12	.1205	.116	.188	.125	11
12	.080808	.109	.1055	.104	.185	.109375	12
13	.071961	.095	.0915	.092	.182	.09375	13
14	.064084	.083	.0800	.080	.180	.078125	14
15	.057068	.072	.0720	.072	.178	.0703125	15
16	.05082	.065	.0625	.064	.175	.0625	16
17	.045257	.058	.0540	.056	.172	.05625	17
18	.040303	.049	.0475	.048	.168	.05	18
19	.03589	.042	.0410	.040	.164	.04375	19
20	.031961	.035	.0348	.036	.161	.0375	20
21	.028462	.032	.03175	.032	.157	.034375	21
22	.025347	.028	.0286	.028	.155	.03125	22
23	.022571	.025	.0258	.024	.153	.028125	23
24	.0201	.022	.0230	.022	.151	.025	24
25	.0179	.02	.0204	.020	.148	.021875	25
26	.01594	.018	.0181	.018	.146	.01875	26
27	.014195	.016	.0173	.0164	.143	.0171875	27
28	.012641	.014	.0162	.0149	.139	.015625	28
29	.011257	.013	.0150	.0136	.134	.0140625	29
30	.010025	.012	.0140	.0124	.127	.0125	30
31	.008928	.01	.0132	.0116	.120	.0109375	31
32	.00795	.009	.0128	.0108	.115	.01015625	32
33	.00708	.008	.0118	.0100	.112	.009375	33
34	.006304	.007	.0104	.0092	.110	.00859375	34
35	.005614	.005	.0095	.0084	.108	.0078125	35
36	.005	.004	.0090	.0076	.106	.00703125	36
37	.004453	.....	.....	.0068	.103	.006640625	37
38	.003965	.....	.....	.0060	.101	.00625	38
39	.003531	.....	.....	.0052	.099	.....	39
40	.003144	.....	.....	.0048	.097	.....	40

A new and simple method for testing eggs is published in German papers. It is based upon the fact that the air chamber in the flat end of the egg increases with age. If the egg is placed in a saturated solution of common salt it will show an increasing inclination to float with the long axis vertical. A scale is attached to the vessel containing the salt solution so that the inclination of the floating egg toward the horizontal can be measured. In this way the age of the egg can be determined almost to a day. A fresh egg lies in a horzontal position at the bottom of the vessel; an egg from 4 to 5 days old shows an elevation of the flat end, so that its long axis forms an angle of 20 degrees. With an egg 8 days old the angle increases to 45 degrees; with an egg 14 days old to 60 degrees, and with one 3 weeks old to 65 degrees, while an egg a month old floats vertically upon the pointed end.

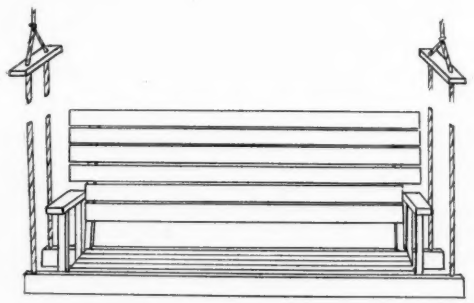
SWING SEAT FOR PIAZZA.

JOHN F. ADAMS.

Swing seats for the piazza are becoming very popular, and the near advent of warm weather leads one to think of fittings which will add comfort during the season when out-door rest is desirable. The seat here described is easy to make and will be found very useful. About any kind of wood may be used except the softest, like pine. It should be stained a dark green or brown to present the best appearance. The lumber required is as follows:

12	pieces	4 ft.	long 3 in.	wide, ¾ in. thick.
2	"	5 "	" and 2 x 3 in.	
3	"	20 "	" " " "	
4	"	13 "	" 1½ x 2 "	
3	"	20 "	" 1½ x 1 "	

The two long pieces and three short pieces of 2 x 3 in. stock are used to make the seat frame, the three cross pieces being blind mortised into the long ones, the mortises for the ends being cut to bring the outer edges of the cross pieces 6 in. from the ends, the other being midway between these two. Good, firm joints should be made, as the strain is considerable. One inch from each end of the long pieces bore holes for the suspension ropes which should be at least ¼ in. diameter.



The arm posts are made from the 1½ x 2 in. stock, the lower ends being firmly screwed to the corners of the frame just made, on the outside of the cross pieces. The arms are 20 in. long, projecting 3½ beyond the posts. They are attached to the posts by stout screws, the heads being countersunk, and covered with putty or wood buttons before staining.

The back is inclined at a regular chair angle and supported by two end pieces of 1½ x 1 in. stock, and a center piece, the two former being firmly screwed to the rear arm posts and the seat frame. The center piece is attached by screws to the slats only.

The slats for both seat and back are spaced equally and fastened with 1 in. wood screws, the heads countersunk.

Two spacing bars hold the ropes apart above the seat, making it more easily managed, as without such bars it is rather easy to get a spill if care is not used in keeping one's balance. These bars should be located as high as space will permit, and held in place by putting wire nails through both bars and ropes. The ropes are brought together above the bars, and it will be found convenient to have two loops to enable the height from the the floor to be changed, as short people will not find it convenient to use unless they can rest their feet on the floor.

The best way to fit the suspension ropes is to make the loops and splice at the top, to fit the spacing bars and fasten to the seat by tying strong knots underneath after the correct height has been found by test. It should be a little high at first if new rope is used, as the latter will stretch. This can be taken up by untying the knots and retying higher up.

The user must also observe care not to swing endwise with the fingers on the arms where the suspension ropes will pinch them. Cushions and sofa pillows add much to the appearance of the seat and comfort of the user.

Piassava is a fiber made from the bamboo tree and is used in Europe to make brooms, brushes, and the like. In Liberia the bamboo is taken from the tree and placed in water until the outer covering decays. It is then beaten in a forked stick, erected for the purpose, until there remains only the fiber, which is weighed and bound in bundles much like American wheat, except that it is bound at both ends. This is the best method of obtaining the bamboo fiber. The other method, beating the bamboo dry, breaks many of the strands and produces an inferior fiber.

Two well-known Chester, Nova Scotia, men, A. M. Church and Mr. Cleveland, the latter a blacksmith, are satisfied that they have succeeded in hardening copper, and E. B. Church has a piece of metal treated by the process which appears to be very hard. He also has a razor made of their hardened copper, with which one can shave. Having been made in a blacksmith shop the razor is necessarily crude, but the blade is hard and carries a sufficiently sharp edge to remove superfluous hair. The elder Mr. Church writes that by the process the metal can be hardened to any degree.

Every amateur mechanic who wishes to keep posted should regularly read AMATEUR WORK.

HANDY HINTS FOR AMATEURS.

Contributions are solicited for this department, and for each accepted article the sender will be given the choice of any one-subscription premium from our premium offers.

A SIMPLE DRAWING TABLE.

C. D. SHRECK.

This table is intended for the amateur who desires to construct his own table at a small cost, and have when completed one that will answer all requirements and be satisfactory in every respect. It is intended to be set up in front of a window, the casing of the window, in fact, acting as the front supports. It may be set in front of any window, but a north window would be preferable, owing to the fact that the sun hardly ever reaches it and the light would be more nearly uniform.

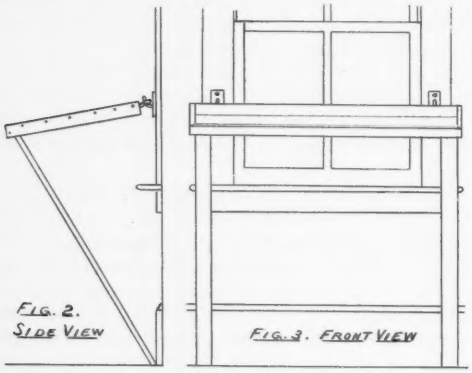


FIG. 2. SIDE VIEW

FIG. 3. FRONT VIEW

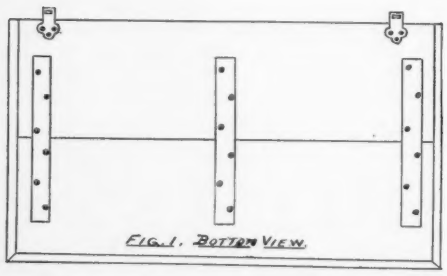


FIG. 1. BOTTOM VIEW.

Procure at a lumber yard a smooth, dry, soft, white pine board, 8 feet long, 12 in. wide and $\frac{7}{8}$ in. thick; also two strips of the same material, each 10 feet long, 2 in. wide and 1 in. thick. This material will cost you about 50 cents. By sawing the board crosswise through the middle you will get two boards, each four feet long. Lay these face downward, side by side, and fasten them together by the means of three cleats cut from one of the strips. Each cleat should be one foot, three in. long and located as in Fig. 1. Then on three edges of the table fasten, by the means of wire finishing nails or round-headed screws, strips cut from the 2 x 1 material. These strips serve to keep the table from warping, hold the back supports in position and add greatly to the general appearance of the table. These strips should be mitred at the ends where they meet each other so as to form a neat joint.

The table should be suspended to the window casing by the means of hangers, such as are employed in hanging window screens. You can procure them from any hardware dealer and the pair will probably cost fifteen cents, screws included. The hangers should be mounted on table and casing, as shown in drawing. The parts of the hangers that go on the casing should be located 46½ in. from the floor and at a distance apart so that the window curtain, in being pulled down, will clear them.

All that remains to complete your table are a pair of supports, each 4 ft. long, cut from the 2 x 1 material. To suspend the table to the casing, slip the hangers together, raise the lower end and place the supports in position, the lower ends resting on the quarter round and floor and the upper ends on the under side side of the table in the corners, between the cleats and strips.

Owing to existing conditions it may be convenient or even necessary to deviate from the instructions here given as, for instance, if you cannot obtain the hangers described, you may substitute hooks and screw-eyes and get practically the same results. But if the general scheme is followed the results will be satisfactory.

ANGLE PLATE FOR LATHE.

FRANK H. JACKSON.

The angle-plate is one of the handiest attachments to a lathe a workman can have, and is one of the easiest to make.

If the tool of tools (the lathe) is used to its fullest capabilities, it can be made to answer for many other machines. Milling, shaping, planing, etc., can be very efficiently done on a lathe with the aid of various attachments, one of which is here described.

In making my angle I used a casting as shown in the sketches, it being, when finished, 4½ in. long and the

shelf part about 2¼ in. wide, which is suitable for a lathe from 7 to 9 in. swing. A pattern for the casting is easily made. I also planed up a piece of hard maple perfectly square 2 x 2½ x 4¾ in. long, and fastened it to the face plate, A, as shown at B, Fig. 1. C is a trysquare testing the upper face of wood which must be exactly at a right angle to the face-plate. Fig. 2 at D, represents the angle-plate casting bolted on the wood block preparatory to turning off one of the faces. The casting must, of course, have some holes drilled to take the necessary bolts to hold it on the face plate; these holes should be put in the proper places so they can be filed into slots, as shown in Fig. 3, which shows the finished angle-plate.

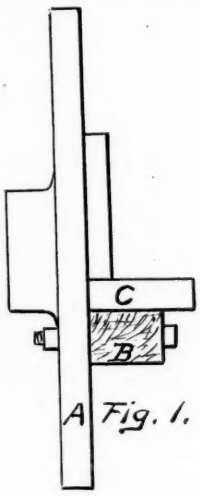


Fig. 1.

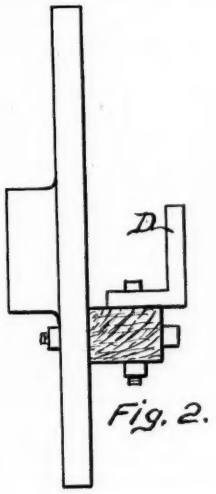


Fig. 2.

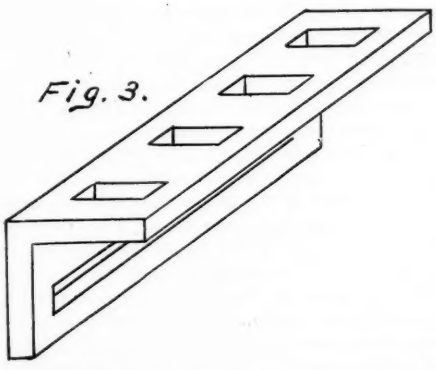


Fig. 3.

After one face has been properly turned off, as shown in Fig. 2. remove it and again bolt it, the turned face down, on the block, being careful to locate it so the cut will cover the entire surface. When this side is properly turned the various slots can be drilled and filed out, the edges trued up, and, if care has been taken, you will have an angle-plate that will answer the purpose as well as one costing a considerable amount.

If a suitable casting cannot be obtained a piece of wrought iron rolled angle plate will answer the purpose. Look over scrap piles; they often contain pieces that can be used to good advantage.

The amateur mechanic should make all the tools and lathe fittings he can, rather than buy them, as by so doing he gains valuable experience, and when he comes to make an engine, or some other larger machine, he can go at it with confidence that he can build it.

SCIENCE AND INDUSTRY.

A grammaphone which, it is said, can be heard at a distance of three miles is the latest invention of the Hon. C. A. Parsons, of turbine fame. The instrument, which was exhibited privately at Metzler's Hall on Monday, is named the auxetophone, and is worked by means of compressed air. This is pumped in by a small engine at a pressure which can be adjusted up to over 3 pounds, through a small valve, which takes the place of the ordinary diaphragm, into the trumpet. The valve consists of a number of small slots, covered with a fine comb, not unlike the mouth organ, and the vibration of this comb produces the sound. On a calm, windless day, it is estimated that, with a high pressure, the record could be distinctly heard three miles away.

Various metals which are themselves non-magnetic, may form alloys which display magnetic qualities; some of these have been produced in recent experiments. Aluminum, copper and manganese are all non-magnetic, but when combined in certain proportions, an alloy of considerable magnetism is produced. As no alloy of copper and aluminum alone is magnetic, this effect must be ascribed to the manganese, and yet this metal alone, as well as copper and aluminum, remained non-magnetic when cooled to the temperature of liquid air. An alloy of manganese with iron is practically non-magnetic, but with the same manganese a magnetic copper alloy can be made.—"Engineering Review."

In some experiments carried out at the Iowa State College by Messrs. H. T. Borsheim and L. C. Moody on the efficiency of steam-pipe coverings, it was noted that with a steam pressure of 20 pounds per square inch in the pipe the loss in a bare pipe amounted to 2,405 B. T. U. per hour per square foot per degree of difference of temperature. With 40 pounds of steam the corresponding figure was 2,589, with 60 pounds of steam 2,686, with 80 pounds of steam, 2,752, and with 100 pounds of pressure, 2,897 B. T. U. per hour per square foot and per degree of temperature difference.

The electrical resistance of the human body as a whole is also beginning to receive attention, with some unexpected results. Herr E. K. Muller, in a paper contributed by him to a Swiss technical journal, tells us, as the outcome of some careful experiments made by him, that it is by no means uniform with all individuals, although it is for the most part somewhere near to 3,000 ohms. So wide are the variations that he is led to believe that every person has a normal resistance peculiar to himself or herself. But apart from this, it varies from moment to moment in response to every emotion from within, and nearly every sensation coming from the outside world. By carefully insulating his subjects, Herr Muller found that the entrance of a stranger into the room where the experiments were conducted caused an instant variation, as did the exertion of speaking, the falling of a ray of light upon the eye, the attempt to listen, or the perception of a powerful smell. He thinks that this hitherto unsuspected sensitiveness of the body accounts in great part for the images seen in dreams. He finds, too, that the resistance is very low with whole classes, such as persons accounted "nervous" and smokers and drinkers. With the hypnotized there is a wonderful tranquillity, or invariability of the resistance, so long as the patient is undisturbed, coupled with an increased sensitiveness to external sights and sounds.

The largest double-throw crankshaft in the world was recently forged under the 4,000 ton hydraulic press of the Bethlehem Steel Company, South Bethlehem, Pa. The shaft is one of three ordered by the International Steam Pump Company. It will be, when finished, 27 ft. long. The largest pin diameter is 37 in. The webs in extreme dimensions will be 64 in. by 49 in. and 16⅝ in. thick. The weight of the ingot was 240,000 pounds.

TRADE NOTES.

"Some interesting Facts" is the title of a well gotten up booklet issued by E. Atkins & Co., Inc., Indianapolis, Ind., which presents the points of merit of the goods manufactured by this company. Every woodworker should send for it, as it contains several pages of items of general interest.

G. & H. Barnett Co., The Black Diamond File Works, Philadelphia, Pa., are mailing a new edition of their illustrated catalogue of files and rasps. Every user of files, and especially instructors of manual training should have this catalogue included in their list, and give a trial order of this excellent make when opportunity presents.

Parsell & Weed, 131 W. 31st Street, New York City, are mailing a bulletin of dynamo castings, and complete experimental outfits of quite a substantial type, the output of the dynamos ranging from one tenth to three-quarters kilowatt, according to speed at which it is driven and construction of fields. It is just the thing for lighting a small residence and should prove of much interest to those who are desirous of fitting up such private plants. About 1 h. p. is required to drive it to the fullest capacity.

The exceptional facilities offered by Hammacher, Schlemmer & Co., 4th avenue, New York City, for promptly filling orders for a wide range of tools, should be of value to those interested in the purchase of equipment for the Manual Training Schools. By placing the order with this company, about everything required could be obtained on one bill, thus avoiding duplication of checking up and auditing, etc., to which school orders are subject.

The amateur boat builder who is desirous of building a boat and has as his only guide drawings of a reltively small scale is, under the circumstances, obliged to lay out the lines on a large, smooth floor surface, which is, in many cases, not available. It is important that this be done, as it is the only way in which patterns may be secured which will fair up, one part with another, and no beat, except the very simplest of skiffs, should be attempted without such laying out. Where this is not possible or, because of inexperience, lack of time, or other reasons, the builder does not wish to do this part of the work, the patterns to be had of the Brooks Boat Manf'g Co., 4205 Ship Street, Bay City, Mich., are of exceptional value, as their use ensures a good boat with a minimum of work in fairing up. Boats can be built much quicker with such full size patterns than without them, and our readers interested in boat building should write for particulars.

Are you a sportsman? Well, if you are, you ought to know that the first salmon in the famous Bangor Pool was landed twenty minutes after the law went off April 1st. Yes, the disciples of Isaac Walton were fishing in Bangor Pool at 12.01, A. M., April 1st; but did you know that the fishing season is now on in earnest? Why, the lakes and ponds of Maine are all opened up now, and "they're" hauling out the big ones! Sebago is sending away some choice samples of the Ounaniche or land-locked salmon; the Rangeleys are gathering the experts; the trout streams are being whipped; Moosehead is welcoming her visitors; the Dead River region is as popular as ever with the salmon and trout fishermen, and in the upper Kennebec Country, such fishing grounds as Carry Pond, Lily Pond, Embden Pond, Otter Pond, Moose Pond, Lake Austin, Pleasant Pond and Pierce Pond are all ready for the sport. In New Hampshire at Winnipesaukee, Sunapee and Newfound Lakes, and in Vermont at Memphremagog, Willoughby and Champlain they have been filling their creels for several weeks. A two cent stamp, sent to the General Passenger Department, Boston & Maine Railroad, Boston, will bring you a beautiful illustrated booklet, "Fishing and Hunting," also a booklet giving the fish and game laws of Northern New England. Be sure and send for one; you can't afford to go away without these requisites.